RAILROAD GAZETTE

FRIDAY, JUNE 29, 1900.

CONTENTS

The Reports of the Master Mechanics' Association.

We give below extracts from most of the reports presented at the convention of the Master Mechanics' Association and on another page will be found a short summary of the most interesting points brought out. The reports of the Master Car Builders' Association were treated in like manner in our issue of last week.

RELATIVE MERITS OF CAST-IRON AND STEEL-TIRED WHEELS.

The only report giving data has been received from the Union Pacific R. R., in which they state that the average cost of mileage of 33-in. cast-iron freight car wheels is 8 cents per 1,000 miles; the average cost of steel-tired wheels is 45 cents per 1,000 miles. Mr. G. W. Rhodes, of the Burlington & Missouri R. R., advises that he is of the opinion that a 33-in. cast-iron wheel made to the M. C. B. standard test is a safer wheel than some of the steel-tired wheels on the market.

Under these circumstances, the committee is unable to add anything additional to the report printed in last year's proceedings.

This report is signed by J. N. Barr, Chairman; A. M. Waitt, H. S. Hayward, A. L. Humphrey and John Hickey.

TON-MILE BASIS FOR MOTIVE POWER STATISTICS.

In the report of this committee presented at the 1899 meeting of this Association, we argued at length and in detail that all the items involved in the cost of engine service statement should be based on the ton-mileage produced. It is not our intention to present this matter at length in our present report, but wish to emphasize the conclusions reached in that report by an illustration taken from a performance sheet for January, 1900, in which is shown the records made on the mile and ton-mile bases.

Cost per mile—	Moguls, Simple. 19 by 24 in. Cents.	Consolidations, Compound. 21 and 31 by 24 in. Cents.	Per cent. in favor of Simple Engines.
Oil and waste	.24	.30	25
Fuel	14.81	15.84	7
Repairs and supplies.	2.51	5.08	103
Wages	6.93	7.63	10
Total	24.49	28.83	18

Cost per 10,000 ton-miles.			Per cent. in favor of Compound (except * *).
Oil and waste	$0.04	$0.03	33
Fuel	2.44	1.77	38
Repairs and supplies	.41	.58	40 * *
Wages	1.14	.85	134
Total	$4.03	$3.23	25

We believe the showing in the above table is a sound argument in favor of the use of the ton-mile basis, and for all the items making up the cost of engine service. We believe it advantageous to also have a statement showing the cost of engine lubricating and illuminating oils on the engine-mile basis.

Comparison of Statistics.—In our previous report we also argued that greater economies will be secured by comparing the statistics for a given system or division with those made by the same line in previous years, rather than with those of other roads, because when the comparison is made with other roads the conditions, which very largely control results, are, almost as a matter of necessity, so different that a just comparison can not be made; while this is not true when the comparison is with previous records made on the same line. In this report it is our intention to only emphasize this point and refer to our previous report for the extended argument.

Statistics.—Replies to our letter were received from fourteen roads using the ton-mile basis for their motive-power statistics. The operating departments of thirteen of these used the ton-mile basis for their statistics. The ton-mileage is compiled from the conductors' reports, usually in the Car Accountant's office, though there are two roads on which the work is done in the office of the Superintendent of Motive Power, one where the Auditor is in charge of it, and one where it is worked up by the Store Department. On five roads the net tonnage, or that in the cars, is kept separate from the gross, while on nine it is not so separated. There are eight roads which do not include the tonnage of the engine in their ton-mileage and five which do; four do not include the way-car and nine do. East and west-bound ton-mileage is kept separately by eight roads and is not by six. All the roads reporting, use the ton-mile basis for freight service; nine for passenger and freight, and three for passenger, freight, work and switch engines. None of the roads in their ton-mileage add a per cent. to the weight of empty or partially loaded cars to account for the additional power required to haul a ton of these as compared with fully loaded cars, though a number of them add it to their tonnage ratings. It is difficult to surely say from their answers whether any make a practice of determining the actual weights of their cars and their contents except from the way-bills and stenciled weights, but it is evident that a number weigh the loaded cars where practicable. On eleven roads the statistics for the main line and branches are shown separately. Of the nine roads which keep their passenger service statistics on the ton-mile basis, seven add nothing to the weight of the cars for passenger baggage, express or mail, while two do. One adds to the scale weight of their coaches, chair cars and sleepers, two tons; to that of their baggage and mail cars five tons for their contents. Another adds three tons to all their cars in passenger service.

What Service Should be Included?—The chief reasons for adopting the ton-mile basis for railroad statistics, in place of the mile basis, are that the former is a more accurate measure of the work done, and encourages economy in operating. We can see no good reason why these qualities are not as desirable for passenger service as for freight, though it will be admitted that greater economies will result in freight service. It is urged by some that the speed and weight of trains in passenger service are not within the control of division officials, implying that there is little use in trying to improve the records for this service, therefore there is no use in using the ton-mile basis for these statistics. This reasoning applies with equal force to a large proportion of freight service, such as stock, fruit express and fast merchandise, but is not considered to have sufficient weight to prevent the use of the ton-mile basis. We know that some men are more economical than others in passenger service, as well as in freight, and believe the use of the ton-mile basis is better than the engine-mile basis with which to determine their relative merits, and so encourage better records. It also seems to us desirable that both passenger and freight service statistics be on the same basis. This is apparently the view of nine out of the fourteen roads reporting, or nearly 65 per cent. To the actual weight of cars in passenger service we would suggest the addition of five tons for mail, baggage and express cars in main line service, three tons for such cars in branch-line service, and of two tons for such cars as carry passengers, whether in branch or main line service. Passenger cars hauled deadhead in freight trains should have no such credit.

Engines in work train and switching service are credited with an arbitrary number of miles per hour. We see no reason why they should not be credited with an arbitrary ton-mileage instead, which would give the same basis for the statistics of all classes of engine service which we believe is important and desirable. Nearly 22 per cent. of the roads reporting are of this opinion. We would suggest that work engines be credited with the actual weight of their trains, to be determined on the same basis as for freight engines, and with 10 miles per hour. If the weight of the train is 500 tons, and the engine is in service 10 hours, the credit for the day's work would be 50,000 ton-miles.

For 18 x 24-in. switch engines carrying 145 lbs. of steam pressure and having 50-in. driving wheels, we would suggest a credit of 200 tons and eight miles per hour. For a day of ten hours this would make a credit of 16,000 ton-miles. For other switch engines the tonnage should be proportional to their power as determined by the formula in the next paragraph. The credit for pusher and double-heading engines should be made on the basis of the proportional power of the engines attached to the train. This is quite easily determined by means of a table which can be made in the drawing-room, from the formula $T = \frac{d^2 p s}{D}$, in which T is the tractive power, d the diameter of the cylinder, p 85 per cent. of boiler pressure, s the stroke, and D the outside diameter of the drivers; all the dimensions in inches and the pressure in pounds.

We would sum the argument for the use of the ton-mile basis for all classes of engine service as follows: It is the most accurate practicable basis for measuring the work done in freight and passenger service; an arbitrary ton-mileage credit for switch engines is as accurate as an arbitrary mileage credit and has no disadvantages; for work engines a credit for the actual tonnage handled and an arbitrary mileage per hour is more accurate than a credit of an arbitrary mileage only; it is desirable to have the same basis for all the classes of engine service.

What Tonnage Should be Included.—There are evidently differences of opinion as to what tonnage should be included in making statistics. Some are decidedly of the opinion that the entire weight of the train, including the engine, tender and way-car, should be used. Others contend, with equal conviction, that only the weight of the cars and their contents, excluding the way-car, should be used. It is quite possible that this difference of opinion may in some cases be due to a confusion of the terms "ton-mileage" and "tonnage rating." The ton-mileage of a locomotive for a given trip is ascertained by multiplying the weight of its train, reduced to tons, by the number of miles this tonnage is hauled. The tonnage rating of the same engine is quite a different matter, being simply the number of tons it is rated to handle, and does not necessarily have any relation to its ton-mileage. As the weight of a given engine and its way-car is always the same, there is no good reason why the tonnage rating should include these weights, as the object of the tonnage rating is simply to always secure a weight of train which shall be the greatest practicable under service conditions.

It may seem that this line of reasoning should be applied to the ton-mileage, and that, because there is nothing gained by including the tonnage of the engine and caboose in the tonnage rating, therefore it should not be included in the ton-mileage. It seems to the committee that this does not logically follow, because the object of the tonnage rating and that of the ton-mile basis for statistics are entirely distinct. The tonnage rating is used as a measure of the capacity of the locomotive, while the ton-mileage is intended to show the work actually done, regardless of whether the tonnage rating is handled or not, as a basis for the cost of engine service.

One of the favorite arguments of those who favor the exclusion of the ton-mileage of the engine and way-car is that the management wants to know what their engines are hauling behind the tender. Admitting, for the sake of argument, that this position is correct, no better statement could be made to show that the weight of the way-car should be included in the ton-mileage. In short, that it is more important that the motive-power statistics be based on a ton-mileage which will represent as nearly as practicable the total work returned for the money spent than to leave out of the account a considerable percentage of the work done for the sake of exceptional conditions. We believe that the motive-power department, rather than the management, has been responsible for the use of the engine-mile as the basis for statistics, and has generally taken the initiative in urging and adopting the ton-mile basis for its department. In short, that, as a rule, the manager has been so fully occupied with other matters that he has not given the necessary time to a careful study as to what basis for motive-power statistics is the best, but that the use of a given basis has been sanctioned as the result of the representations of motive-power officials. It will be admitted without argument that the management is interested in knowing the cost of motive-power management, but we believe it is specially interested in the broader field of operating cost, and that we will fall short of our duty if we do not fully represent the matter from our standpoint, and can not fairly be considered as going outside our province if we venture to assume that, from the nature of the case, we should know our needs better than those who have not specially studied them. If this statement is reasonable, it follows that the interests of all concerned would be best served by a joint committee representing the operating and motive power departments, which should consider the subject for both.

Viewing the matter from a strictly motive-power standpoint, we are of the opinion that the ton-mileage should include the entire train—the engine, the cars with their contents, and the way-car. The strongest argument in favor of this view is that the best basis for determining motive-power costs is that which includes all the work produced by the money spent.

Under the head of "Statistics" it is worth noting that, of the fourteen roads reporting, on all but one, the operating department uses the ton-mile basis for their statistics. The needs of the operating and motive-power departments in this matter are quite different. The operating department wishes to know the per cent. of empty to loaded ton-mileage, the per cent. of actual to rated ton-mileage, the average tonnage of load per car, so that the per cent. of useful work may be increased. On the other hand, these matters are of minor interest to the motive-power official, and then only as they affect the efficiency of his department. The motive-power officer is interested in knowing the actual work performed, not with a view of bettering the efficiency of the operating department, but his own.

If our statement of the case is correct, it follows that there are three interests to be served by ton-mileage statistics: Those of the management, which wishes to know the cost of handling a ton of freight one mile; those of the motive-power department, which we believe is entitled to a credit for all the work performed by the money it is responsible for; and those of the operating department, which finds the ton-mile basis the best practical one for reducing the per cent. of unproductive work in handling their trains. If this is a fair statement of the case, it follows that the needs of no two of the departments are the same, and therefore a compromise will serve the best interests of neither. It will be admitted

that the management is interested in the statistics of both the other departments, but we venture to assume we are warranted in believing that it is to the best interests of the management to allow each such a basis for their statistics as will favor its greatest efficiency.

It is probable that the ton-mileage statistics of the operating department should show separately, that for the lading, for the loaded cars, for the empties, and east and west-bound traffic, in order to be of the greatest usefulness. If this is correct, it follows that the additional expense for furnishing the ton-mileage for the management, which should show only that for the contents of the cars, would be only that necessary to draw off these figures as a separate statement from among the totals needed by the operating department. It would therefore appear that the expense for ton-mileage figures for each department best suited to its uses, would be but very little greater than for a compromise statement which would serve the best interests of neither.

The preceding argument has referred only to the expense for compiling the ton-mileage. We believe it safe to assume that the expense for figuring out the statistics based on ton-mileage will, after the first year, be no greater than it has been for furnishing the corresponding statistics on the mile basis. This has been the experience of others and seems a reasonable proposition. If the ton-mile statistics are more elaborate, it will follow that the expense will be somewhat increased. In this connection it is worth noting that for the first year the ton-mile statistics are used, it will be necessary to keep those based on the mile, if a comparison of one year with another is desired.

Conclusions and Recommendations.—The ton-mileage for the use of the motive-power department should include the weight of the entire train.

For the use of the operating department it is probable that all that is needed is the weight between the tender and way-car.

The best interests of both departments will be best served by a joint committee representing both.

For the Motive-Power Department.—We recommend that all the items making up the cost of engine service be on the ton-mile basis; that the statistics of all classes of engine service be on the same basis; that in passenger service five tons for mail, baggage and express cars in main line service, three tons for such cars in branch line service, and two tons for all cars carrying passengers, be added to their scale weights; passenger cars handled deadhead in freight service should have nothing added to their scale weight; that engines in work train service be credited with the actual weight of the entire train, to be determined on the same basis as for freight engines, and with ten miles per hour; that switch engines having 18 x 24-in. cylinders, carrying 145 lbs. steam pressure and having driving wheels 50 in. outside the tire, be credited with 200 tons and eight miles per hour; for others the tonnage should be in proportion to their power, compared with that of the standard, and eight miles per hour; that for pusher and double-heading service the credit for each engine attached to the train be its proportion of the ton-mileage, based on its power, for the distance covered by each; that it is desirable to group the individual fuel statement and oil statement, each service by itself; that the statistics for main line and branches be separate; that the weight of the contents of freight cars handling way freight should be that with which it left the terminus; that the ton-mileage of mixed trains, where both freight and passengers are handled in the same train, should be credited to that service which is entitled to the greatest per cent. of it, and that the tonnage of a locomotive should be its weight in working order plus that of the tender with half its capacity of coal and water.

This report is signed by H. J. Small and C. H. Quereau. W. H. Marshall, the third member of the committee, disagreed with some of the recommendations and declined to sign.

FLANGED TIRES.

The original report presented one year ago contains the results obtained at that time, which results the committee did not consider to be conclusive on account of the difficulty experienced in taking the readings of the dynamometer that was placed between the engine being tested and the engine doing the work. The results now presented, in the opinion of the committee, can be taken as conclusive and reliable, inasmuch as they were obtained with a self-registering dynamometer car of approved construction. For information concerning present practice as to tire arrangement on mogul, ten-wheel and consolidation engines, reference is made to the first report.

It was decided to do the work with a self-registering dynamometer car, the tests to be made on the Lehigh Valley at the same place where the tests were made one year ago. The tests to include not only a consolidation engine, but also an engine of the ten-wheel type. It was furthermore decided that the track on which the tests were to be made should be put in first-class shape with elevation and gage on the curve to represent what is the average practice at the present time. It was decided that a test should be made with a ten-wheel engine, and with each tire arrangement, on straight track, to ascertain the lateral motion of the engine. It was agreed that both engines to be tested should be engines just out of the shop with the lateral motion between the hub of wheel and box, 1-16 in. on each side. These plans were carried out.

The track where the tests were made was laid in 1900 with 100-lb. rails on good ties with tie plates and consisted of 476 ft., between station flags, of 14° 30′ curve; the grade, in the direction the test trains were run, was upward, 56 ft. per mile; the outer rail was elevated 5 in. and the gage on the curve was 4 ft. 8¾ in. The lateral motion of the ten-wheel engine on straight track with each tire arrangement was determined with an instrument known as a hydrokinetimeter. The spacing of the wheels, weight on each pair of wheels, etc., of both engines are shown in Figs. 1 and 2. With both engines the main rods and valve rods were disconnected, the boiler and tender cisterns were full of water, and there were about two tons of coal on each tender.

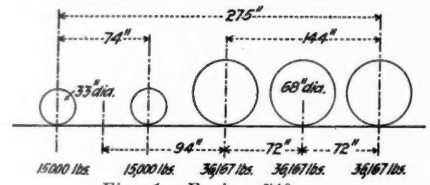


Fig. 1.—Engine 710.

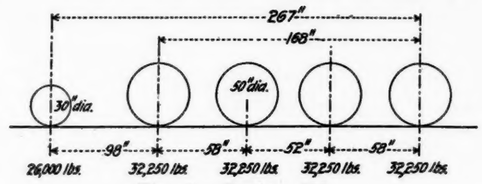


Fig. 2.—Engine 689.

With Master Mechanics' Report on Flanged Tires.

The dynamometer tests were made by hauling the engine to be tested through the curve, entering at the lower end so as to have the grade to contend with, at speeds approximating 10, 20 and 30 miles per hour for each engine, with each tire arrangement. The start was made at a sufficient distance from the first flag, to enable the engineer to get the test train at the desired speed when passing that flag. The test trains were made up in the following order: First, Engine hauling train; second, dynamometer car; third, engine being tested. The couplings were blocked with wooden wedges, to take up the slack. The hydrokinetic tests were made between two semaphores, 2.63 miles apart, on straight and level track. In making the tests the train was started at the first semaphore, and brought to a speed approximating forty miles per hour, which was maintained until the second semaphore was passed, when the train was gradually brought to a stop.

The distance between the backs of flanges on the engine truck wheels in all tests was 53¼ in. The distance between the backs of flanges on driving wheels, in all tests except No. 6, was 53¼ in. In test No. 6 the distance between the backs of flanges on the front and back pairs of drivers was 53⅛ in., while this distance for the middle drivers was 53¼ in. The plain tires were located on the driving-wheel centers so that the center of the tread of the tire coincided with the center of the rail head on straight track. The tires used were Master Mechanics' standard section; flanged tires 5¾ in. wide, plain tires 6½ in. wide.

A comparison of results of the tests with engine No. 710 is shown in Fig. 3, and with engine No. 689 in Fig. 4.

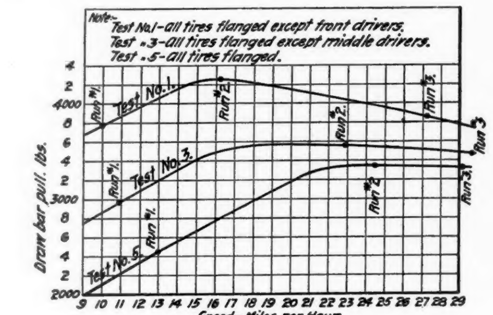


Fig. 3.—Test of Engine 710.

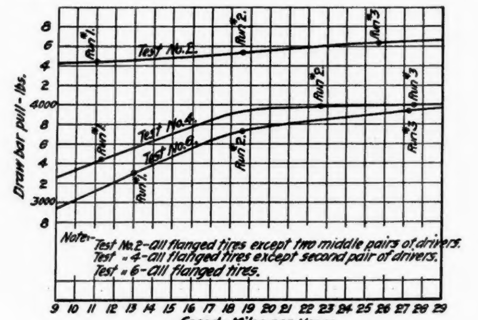


Fig. 4.—Test of Engine 689.

With Master Mechanics' Report on Flanged Tires.

The results obtained from engine No. 710 in the hydrokinetic tests were practically the same at 30 miles an hour for each of the wheel arrangements.

The hydrokinetimeter consisted of a reservoir 18½ in. in diameter and 12 in. deep, with a copper float in the center to enable accurate measurement of the volume of water displaced; the different volumes of water displaced indicating the lateral motion of the engine as affected by the different tire arrangements, and before starting it was filled with water. At the end of the run the water remaining in the instrument was measured and the difference represented the volume of water displaced. The instrument was bolted on top of the fireman's shield, which is fastened to the top of the back boiler head.

The committee held that the tests justified it in concluding that it is desirable to have flange tires on all the drivers of mogul, ten-wheel and consolidation engines. With mogul and ten-wheel engines the tires should be set so that the distance between the backs of flanges will be 53¼ in. With consolidation engines the tires on the front and back pairs of wheels should be set so that the distance between the backs of flanges will be 53⅛ in.; with the other two pair of drivers the tires should be set so that the distance between the backs of flanges will be 53¼ in. It should be understood that the committee assumes that the engines will have swinging trucks.

This report is signed by S. Higgins, W. H. Thomas and Wm. Garstang.

COMPOUND LOCOMOTIVES, BEST RATIO OF CYLINDERS.

This is an excellent report in which is brought together a great deal of information published heretofore in different forms, and there is also much new data which the committee received through a circular of inquiry. In the report proper is a summary of this information and the conclusions of the committee; in the first appendix is illustrated and described the different systems of compounding now used by American locomotive builders; in the second appendix the most important letters from the circular of inquiry are given in full and finally there is a list of references to compound locomotive literature. The following extracts are taken from the report proper:

The advantages accruing from compounding may be summarized as follows:

1. Reduction of expansion in one cylinder and consequent reduction of internal waste.
2. Ability to adopt large ratios of expansion with light loads without wire drawing.
3. Reduced leakage in engine.
4. Reduction of depreciation of boiler.
5. Greater boiler efficiency.
6. Lighter blast, smoother draft, less waste, annoyance and danger from sparks ejected from locomotives.
7. Elevated limit of speed and power.
8. Reduced loss by tender and fuel haulage.
9. Greater uniformity of crank movements.
10. Larger efficiency of machine.

To offset these gains, there are losses which may be enumerated as follows:

1. Increased first cost.
2. Increased cost for repairs and maintenance of machinery due to multiplicity of parts and greater weight of reciprocating parts. * * *

It was not until the year 1889 that the American builders constructed a compound locomotive. From that time there has been a constant increase in the number built, interrupted only in 1894 and 1895, probably by the panic, until, in the year 1898, the number of compound locomotives produced was over 30 per cent. of the total output in several plants, and, in 1899, 45 per cent. of the total output of one prominent company was compound. The growth in numbers and the interrupted progress is seen in the table showing the total number of all types turned out each year by the builders in the United States:

1889	2
1890	9
1891	100
1892	263
1893	237
1894	38
1895	73
1896	195
1897	142
1898	348
1899	371
Total	1,778

These figures do not include the compounds built by different railroads for which the different locomotive works might or might not have furnished cylinders. * * *

In view of the data and the opinions expressed in the answers to the circular of inquiry, the committee believes the following conclusions are justified:

1. Compound locomotives have not come into general use in America, but are gradually emerging from the experimental stage.
2. Compounds have been in use in freight service longer than passenger service and there are more in such service; but in recent years there seems to be a disposition to use them also for fast, heavy passenger service. The compound is not as well adapted to switching service as the simple engine.
3. The ton-mile system forms the basis of comparison between compound and simple locomotives. The average saving of the compound in coal consumption is 16.5 per cent.
4. The actual saving of the compound depends upon the price of coal. The greatest economy will be attained where the compound is worked continuously, well up to its limit. The opportunity for saving is greater in freight service than in passenger.
5. The compound is not so flexible an engine as the simple.
6. There should be no difference in the size of drivers between the compound and simple engine in the same service.

7. The compound may be successfully pooled, if such practice is followed, with simple engines.

8. The rating for compounds should be no higher than simple engines of the same class, weight and steam pressure.

9. If it be desired to work the engine simple over maximum grades, the rating may be slightly higher for the compound than for the simple engine.

10. The correct ratio of cylinders is difficult to determine, as other factors than the determination of such ratio as will secure the minimum cylinder condensation enter into the question. In the two-cylinder type it is of paramount importance that the work in both cylinders be equalized as closely as possible for all positions of the reverse lever. This is easier accomplished if the ratio be kept down, and in freight engines it seems that a ratio of about 2 1-3 to 1 would be acceptable, while for passenger a slightly higher ratio, 2.37 to 1, might be used. For the four-cylinder compound the most important question is that of equalizing the pressure on the high and low pressure pistons, and a ratio of 3 to 1 gives good results.

11. Manual control of the compounding feature is preferable to the automatic.

12. There is no necessity for having any trouble due to the use of a large cylinder if proper care be used in the design of the piston.

12½. There is less danger of setting out fires from the stack of the compound than of simple engines.

13. It is necessary to relieve the cylinders while drifting, large relief valves being used on four-cylinder compounds, and the by-pass on two-cylinder compounds.

14. The piston valve is preferable to the slide valve, as more perfect balance is secured, and consequently less wear of valve and seat and less strain on the valve motion.

15. When comparisons have been made between compound and simple engines, the pressures were usually the same.

16. In starting it is necessary to work the engine simple; that it is bad practice to so rate the engine that it will be necessary to work it simple over heavy grades.

17. Engineers are apt to abuse the privilege of working the engine simple. With the same supplies at hand for the repairs on compound engines, there is no necessity for the compound remaining out of service for repairs any longer than the simple engines.

19. The cost of boiler repairs is less on the compound and may average 19.6 per cent. less than for the simple engine.

20. The cost of maintaining the machinery on the compound is a little more than on the simple.

21. The cost of lubrication on the compound will be about 15 per cent. more than on the simple engine.

22. The compound will be an economical machine whatever the price of fuel.

23. More compounds are in use where the fuel is expensive than where it is cheap.

23½. There is no necessity for any difference in the size of the exhaust nozzle of the compound and that of the simple.

24. Many and careful comparisons have been made of the relative performance of the compound and simple engine, and the position of the compound in railroad economy may now be determined.

25. It is possible to build a compound that will give tractive power equal to that of any of the simple engines.

26. The low-pressure piston will give better results if made of cast steel with a bronze bearing ring cast in its periphery.

27. The most notable improvements have been in the intercepting valve, in steam distribution and better design of the machinery.

28. Attention is called to the necessity of further improvement in design of machinery, intercepting valve and steam distribution.

29. With the modern machines the compound holds its place as against the simple and it is not advisable to change any in use into simple engines.

This report is signed by J. F. Deems, A. E. Mitchell, John Player, J. E. Sague and J. H. Setchel.

PISTON VALVES.

It is not the intention of the committee to go into all the numerous details of piston valve constructions that have been tried, inasmuch as most of the variations are not affect the general result. The committee feels, however, that it can cover the important features in this report and speak with reasonable certainty. Nearly all of those reporting as having had experience with the piston valve speak favorably of it, and this, in the judgment of the committee, is satisfactory evidence that it has merit. The advantages of the piston valve are generally stated as follows:

For steam pressures exceeding 185 lbs. the piston valve the result of individual opinions as to construction and do offers considerably less resistance than the slide valve, thus reducing the work the entire valve-gear must perform, and reduces the internal resistance of the locomotive, which is thought to be considerable in modern high-pressure engines. For steam pressures higher than 185 lbs. the question of valve lubrication is very much simplified and the difficulties of cut valves and seats are very much diminished. The cost of maintaining the piston valve seems to be no greater than that of maintaining the slide valve. This statement is not based on a large number of figures, but rather on the judgment of those using the piston valve. The area of admission and exit openings can be very materially increased with the piston valves, which, with higher power locomotives, seems to be a very important advantage, and it is well known that, in order to obtain the highest efficiency from a locomotive, it is not only necessary to get the steam into the cylinder promptly, but to get it out again. These are, in short, the advantages of the piston valve that seem to have been demonstrated. The committee believes that, in adapting the piston valve to the simple engine, the internal admission type has possibly a slight advantage in that the loss of heat of steam going into the cylinders is somewhat less than in the case of the external admission type. Some railroads and locomotive builders, when designing valve-gear for piston valves having internal admission, made a mistake, assuming that the valve gear as designed for external admission would answer for those with internal admission. Practice develops that this is a mistake, and that in order to obtain the proper steam distribution, the valve gear must be specially designed for the internal admission.

One point in piston-valve construction, that has been found to have a material effect on steam distribution, has been somewhat overlooked, namely, the difference in area between the forward and rear end, the area of the rear end being reduced by the area of the piston rod; the two ends are therefore out of balance, and as a result the motion of the valve in one direction is deranged as compared with the motion in the other direction, inasmuch as the lost motion in the valve-gear is taken up in an opposite direction from that which is ordinarily the case. This is based upon experiment on the part of the committee, and from the statement of an individual to the effect that a locomotive equipped with piston valves ran for quite a distance with one of the valve-stems broken, the valve making its regular movement by being pushed ahead by the end of the broken valve-stem in one direction, and pushed back again in the opposite direction by the excess pressure on the forward end of the valve.

The committee finds a great variety of packing used for piston valves. It can be said, however, with perfect certainty that plain snap packing rings will give entirely satisfactory service.

This report is signed by S. P. Bush, Chairman; Wm. McIntosh and H. Schlacks.

JOURNAL BEARINGS, CYLINDER METALS AND LUBRICATION.

This is a report based on answers to a circular letter and no attempt is made to reproduce more than the conclusions of the committee.

Cylinder Mixture for High-pressure Engines.—A number of roads described the cylinder iron used by giving the proportions of particular brands which, outside the locality in which they are used, are probably unknown. The committee considered that such specific mixtures can only be used as an illustration of practice in different parts of the country where the different special irons are in convenient freighting distance, and a universal mixture would be an absurdity. The nearest approach would be a mixture of irons that would give a certain chemical analysis which practice had determined would give the best results. The data at hand, however, is too limited for the committee to go any further.

Casting Saddles Separate from Cylinders.—We believe that eventually it will be found that on account of the shearing of bolts that secure the cylinder to saddle and other failures incident to three pieces instead of two and to high pressures, a three-piece construction will prove to be more objectionable than a two-piece one. It would seem that the proper course to pursue when the two-piece construction is found to be weak would be to strengthen the parts that are weak, and not condemn the design as bad. The deduction of the committee from the replies would be that cylinders and saddles in one piece can be so designed, molded and handled in the foundry as to give perfect satisfaction. One road, however, has been for the last two years using the three-piece cylinders and saddles, and from observations made at different times it seems they are having great success not only in keeping the cylinders secured, but they have been able to reduce to a minimum the time in which to apply a new cylinder. The method pursued by this road allows a different metal to be used in the cylinders than that in the saddle; that is a hard metal can be used in the cylinders and a softer metal in the saddles. This arrangement seems to have advantages over the two-piece cylinder and saddle.

Solid Piston Heads.—It is the opinion of the committee, that extraneous circumstances would have a tendency to control the use of solid pistons. For instance, a road where considerable drifting is done might have extraordinary cylinder wear with solid piston without ready means of regulating unless a continuous piston rod should be used; in that case but little difficulty should be experienced and a much more safe and economical solid piston used. Again, on other roads where very little drifting is done and steam is used in the cylinder constantly, very little trouble should be experienced with solid pistons, especially where high pressures are used. The committee is also of the opinion that those roads using 20-in. and larger cylinders will of necessity be compelled to use solid pistons, and of steel, in order to secure the requisite strength and keep within the desirable weight limit of piston. It is also questionable whether it will cost any more, with modern machinery, to renew an entire solid piston head than it would to renew bull rings with consequent facing of spider, follower plates and refitting of follower bolts.

Cylinder Wear.—The committee is inclined to believe that, leaving out of the question drifting, imperfect lubrication, etc., the question of cylinder wear depends upon piston size and weight. The heavier the piston the more rapid the wear in the cylinder and piston. No reason can be seen why, under the same circumstances, the solid and built-up pistons should not wear uniformly, and as the solid piston made of steel can be made much lighter for equal strength, its use would seem to tend toward diminished cylinder wear. Many roads have increased the life of their packing rings very materially, and also noticeably saved cylinder wear, by turning a groove in the center of the outside of the packing ring about 3-16 in. deep and covering one-third of the width of the ring, the explanation being that each ring carries its lubrication with it in this groove in the shape of moist steam, which more than offsets liability of the diminished bearing surface to increase the wear.

Bearing Metals.—The question of proper bearing metal for heavy fast passenger service is an important one, but it would seem from the various replies received, each one having good success with their own mixtures, that it is a question for each road to decide, after taking into due consideration the design of the engine, the weight, bearing surface, road bed and ballast conditions, methods of oiling and quality of lubricant used.

Undoubtedly one of the best metals for locomotive bearings and connecting-rod boxes is what is known as "phosphor-bronze," "S" grade: Copper 79.70 parts; tin, 10.00 parts; lead, 9.50 parts; and phosphorus, .80 parts. The reason this mixture is far superior to any other is owing to the fact that copper and tin phosphorized gives it a greater affinity for lead, by which it will be understood that by the method of phosphorizing employed, copper is made more fluid and in a manner cleaned, which causes it to amalgamate with the lead. Lead being a natural lubricant it has its advantages in the mixture by being held in solution, and in case of a bearing becoming neglected for a short period, the lead in a manner fulfils the want of oil. The most important feature regarding phosphor-bronze or, in fact, any other mixture used for locomotive bearings, is the proper handling in the foundries, as it is quite frequent that the metal will be melted and held in the furnace awaiting the call of the molder, in which case the metal is roasted or burnt, rendering it absolutely worthless as a bearing metal to withstand any friction, and at such times oil or anything else will not prevent it becoming heated. It has often been the writer's experience to find two bearings made of the same lot of metal, but not cast at the same time, to find one run perfectly cool and the other to persist in heating in defiance of all that could be done to prevent it. It is generally understood that phosphor-bronze wears from 40 to 50 per cent. slower than brass.

It is a well-known fact, on account of depression of business the last few years, that the contract price of bearing metal has been reduced until brassmakers have had to resort to substitutes and a great amount of scrap to come out even. Therefore, it is recommended by this committee that a fair price be paid or allowed for bearing metal, then demanding first-class material. For illustration, bearing metal at 10 cents per pound giving trouble heating costs a company more money than bearing metal at 16 cents giving no trouble. It seems that bearing metal should be based on mileage, giving cost per 1,000 miles, and not by cost per pound alone. In conclusion, the committee would state that no matter what the mixture may be, foundry practice assumes almost as important a part as the mixture, to prevent hot bearings, and should be given a careful consideration.

Lubrication of Cylinders and Valves.—It is the opinion of the committee that with the modern lubricator, properly applied and operated, very little difficulty should be encountered in securing proper lubrication to valves and pistons, providing a proper lubricant and enough of it is used.

Oil Holes, Grooves and Pockets in Driving Boxes.—The majority of the roads favor oiling journal driving bearings by carrying oil to the crown cavity, either centrally from one oil pocket on top of box, or from two cavities on the top of box by means of holes drilled at an angle to reach the crown cavity.

The Chicago, Burlington & Quincy replies that it has tried and is still trying oil holes and oil grooves on the side, and has tried to do away with the center oil hole in the top, but thus far with only moderate success. The trouble seems to be that the waste from the driving box is grated up and soon plugs up the grooves and the oil holes on the rear side, and if the box runs at all warm the metal tends to "wipe" over the groove on the front side. On the whole, it seems that the side oiling is of very doubtful advantage.

The Chicago, Milwaukee & St. Paul replies that it considers four recesses for oil on top of driving box as the best practice. The two outside ones to furnish lubrication for the wedge and shoe, with an oil hole about one-third the depth of the recess from the top, the same to be filled with waste and oil from the top in the usual way, the waste to deliver the oil to the wedge through this oil hole; the two center recesses to be the oil reservoir for oiling the bearing. This is also to be filled with waste, and the oil hole from the top of the box to the bearing to enter two distributing reservoirs located about 1½ in. either side of the top center of the brass. It has also had very favorable results from an oil hole drilled vertically through the flange of the driving box, entering the cellar at a point just below the edge of the brass and communicating with a perforated pipe placed in the top edge of the driving-box cellar; by oiling through this hole, the oil is conveyed directly to the cellar and is distributed through its entire length by this perforated pipe. In actual practice, it is noticed that the waste gathers around this pipe, pressing close to the journal, but never

packs or becomes dry or hard, but lubricates constantly, keeping it soft and free.

The Erie Railroad favors a large oil cavity on the top of the box, three oil grooves in the boxes, two ½-in. holes to the middle groove and ¼-in. hole each side to grooves. Separate oil cavity on each side for wedges; two oil holes from each ¼-in. in diameter.

The New York Central & Hudson River favors lubricating at the side just above the center of the axle. Its experience in oiling driving boxes that way has been somewhat limited, although on a number of engines being turned out with holes drilled toward the center of the boxes the result has been very satisfactory.

The Southern Railway replies that it has good results from oilways cast in brass on the outside next to the box. Those grooves are about ⅜ in. wide and run across the brass to within ½ in. of edges; ¼-in. holes located near the end of the groove and drilled through brass and box: grooves are placed, one on top and one on each side of top: one at an angle of about 30 degrees from the center of the axle and perpendicular line. Also, it has good results from an oilway cast in the crown or outside of the bearing, with oil holes drilled through the brass and the box at an angle of 30 degrees from a perpendicular on each side of the oilway in the crown.

The Southern Railway of Peru says that it locates oil holes on the sides of journal boxes and has done away with oil grooves and pockets, depending upon the cellars for lubricating the journals.

The Boston & Maine advises that driving boxes are best oiled by two oil grooves running lengthwise of the bearing located on each side well away from the crown, oil holes leading to these grooves from large pockets in the top of the box.

This report is signed by W. C. Dallas, J. B. Barnes and G. F. Wilson.

POWER TRANSMISSION BY SHAFTING VS. ELECTRICITY.

A comparison of the relative advantages of electric and shafting driving for shop use may be made under the following general headings:

Relative economy in cost of power itself.

Relative convenience of operation and installation.

Relative effect upon shop output and cost of labor.

Economy.

This has been taken to comprehend only the relative cost of operating the two systems, including expense for fuel, attendance, repairs, interest on investment and depreciation. It is the reason most generally advanced for the installation of electric power, but can only be the controlling one where the cost of power is a large proportion of the shop running expenses. In order to compare the relative efficiencies of engine and electric transmission, it will be necessary to subdivide the character of shop plants somewhat. To do this completely would lead to endless complication, but for present purposes the typical plants are:

1. Shop plant in which each building has its own power plant.

2. Shop plant in which all buildings are furnished with power from a central source.

The manner of connection from the prime mover to the tools may be assumed, for an extreme comparison, in either of two ways, namely: (a) shafting method; (b individual tool-driving method.

Taking the first condition, the average efficiency from engine to tools for steam engine transmission is shown to be 50 per cent.; for electric transmission, under condition "a," the shafting losses will be reduced by splitting up long lines and by avoiding cross-belting, so that they will not exceed 20 per cent., or an efficiency of 80 per cent.; and in the electrical elements, the efficiency from engine to shafting is 65 per cent.; therefore the final transmission efficiency will be 52 per cent., as against 50 per cent. in the purely mechanical method; or, practically, a stand-off. Under condition "b," much less shafting will be employed, and the electrical portion may also show a better all-day efficiency, under certain conditions, by the shutting down of idle machines—say, a shafting efficiency of 90 per cent. and an electrical efficiency of 66 per cent., or a resultant of 60 per cent.—showing a small gain for the electrical method.

Taking the second condition and assuming an unfavorable condition for shafting transmission, as in case of a shop having each building with its own boiler plant and one or more engines, and compare this with a case of a central power plant for electric transmission to all buildings, the possible fuel saving in the latter arrangement will result first, from some small saving in power required for each individual building, and second, from some very considerable saving due to the better efficiency of a large engine and boiler plant over that of several small ones. In extreme cases, where large condensing engines displace small non-condensing ones, and in large stations having a uniform load, the fuel saving may readily approximate 33 1-3 per cent., as is shown in an actual case cited elsewhere.

Attendance.—The item of attendance will next be considered. It is made up of three classes of labor—engineers and firemen; care of shafting and belting; electrical repairs. In an electric system the costs can be reduced by consolidating the engine and boiler plants and by the elimination of large and heavy belts, large shaft bearings and the consequent danger from overheating, reducing labor probably one-half; but a new item of expense in care of electric machinery will be introduced, which will about equally affect the other items leaving the whole attendance bill practically unaffected by the introduction of electric shop power in plants of any considerable size.

Repairs.—As to repairs of shafting and belting it is difficult to obtain accurate data, the record of these items being seldom kept separately in shop accounts. The records of one large establishment have, however, been examined by the committee and the saving found in these items, under the electric driving system, is found to be more than sufficient to pay for all repairs to motors and lines. Thus the conclusion seems justified that the repair item will not be materially different under either system of driving.

Interest.—The remaining items of power-cost are depreciation and interest on investment. It is difficult to institute a fair basis of comparison between the first cost of an electric and a steam transmission plant, for the reason that the results sought to be accomplished by the former provide additional shop facilities, and are therefore not rightly chargeable in a substitution sense. Considering, however, the case of simple substitution in a single shop, where the power plant and arrangement and number of tools is retained as before, electric driving is certain to involve a largely increased first outlay—approximately double that for shafting method. But in a modern shop plant other considerations are the guiding ones in the selection of the power system, such as the possibility of labor-saving devices, cranes, etc., and the greater cost of the electric system becomes a rightful charge against the advantages so obtained. Dropping, therefore, any attempt to draw a strict comparison between first costs, it may be said that in estimating the total cost of power machinery it is usual to include an allowance for interest and for a sinking fund, with which to replace the plant when its utility is no longer on an equality with best practice. These items are generally figured together at 10 per cent. on first cost, a sum amounting roughly to one-fourth of the total running expenses of the power system.

Convenience and Shop Output.

These considerations are so closely inter-dependent that they can best be referred to together. The ordinary shop plant with steam power transmission, both in the arrangement of building and of machines, is the slave to the limitations of this system; it must be laid out so that the shafting and engine connection is as direct and simple as possible; the machines must be compactly arranged in parallel lines, and the ceilings and columns designed with special reference to shafting supports. In other words, the tools must be installed with first reference to the application of power and not, as should be the case, with reference to handling the work to the best advantage. Handling operations are of necessity largely by manual methods, and the shop buildings even must be located with the first view to getting the power to them with the least awkwardness and expense. While generalizing in this manner, the committee has not lost sight of the fact that handling and transferring machinery may be operated by other means than electricity, but it is equally true that devices of this nature are of limited practical application, and the broad fact remains that electricity is to be credited with ushering in a new era of labor saving shop devices.

Electrical transmission places no restriction on the location of the machines, and each shop may be planned with a view to handling its product with the least waste of labor and with the greatest convenience of access to the tools. These may even be transported from place to place to the work; further, the partial or entire absence of overhead line-shafting insures better lighting of the shop and conduces to cleanliness. These factors promote cheerfulness and an improvement in both quantity and quality of output.

To clear head room permits the universal application of various forms of traveling cranes for serving the tools and for conveying operations, furnishing the most efficient means yet developed for increasing shop economy; and, as a means of communication between buildings, electric cranes and transfer tables have advantages over appliances of the same nature driven by steam and air.

Special Appliances.—In these electricity shares a large field with compressed air. It must be admitted that air devices have up to the present time received most attention at the hands of the railroad mechanic, a fact in large part due to the lack of practical knowledge of the electrical specialist and to the greater cheapness of air tools. With, however, the general introduction of electric shop power plants and the better acquaintance of practical men with the agency, an extensive application of electric labor-saving devices is certain to result.

Flexibility.—The extension of a shop building or the tool equipment under the shafting system is generally a matter of much difficulty, and the attempt to add to such a plant often results in inconvenient crowding of the tools or to an overloading or complication of the shafting system, a fact which fully accounts for the extremely poor efficiency sometimes quoted for shafting transmission. In an electric system, on the other hand, great flexibility in extension is secured, as new buildings may be placed in any convenient position and additions made to the driving system without affecting the intermediate links.

Speed Control.—The ease of speed control between wide limits of certain types of electric motors is a valuable feature and will result in more frequently securing a greater adaptability of the tool to the work than is possible where a change in speed involves stopping the tool and shifting belts and gearing.

Increase in Output.—This constitutes, in the opinion of the committee, the chief claim of electric transmission to the attention of shop managers, and it follows from the previously mentioned facts, as, by the use of electric handling devices, the tool is quickly served with its work and the product placed in the most favorable position for operating upon and idle time cut down, and, by independent driving, the capacity is increased by reason of the perfect control of speed possible.

Power Required to Drive Machine Tools.

Data for power required for shafting and for certain tools may be found scattered through the transactions of various engineering societies, especially in the papers of Prof. Benjamin, in the proceedings of the American Society Mechanical Engineers, 1896 and 1897, which give valuable figures; but the amount of exact information attainable anywhere is not very considerable. In the nature of things, figures for frictional losses in shafting must be exceedingly variable, and under the plan of connecting the shop power system to one main driving engine, there is no ready means of analyzing the figure of engine-indicated horse-power to determine the consumption of any particular section of shaft or of a single tool.

With the introduction of electric driving, however, the subject is becoming better understood, as it is a simple matter to connect a test motor to a shaft or tool and thus obtain figures from which to design a power plant for maximum efficiency.

Electric Efficiency.—An electric transmission plant varies in efficiency as follows:

Generators	86 to 90 per cent.
Transmission lines	90 to 95 per cent.
Motors	78 to 90 per cent.
Total final efficiency	62 to 77 per cent.

The above are figures for full loads on the different elements and the variation arises from the difference in sizes of units employed and in line losses assumed. At partial loads the machine efficiencies will drop, but the line efficiency will increase, so that the resultant will be nearly independent of the load. In fact, it is generally possible to shut down many of the separate motors when operating the plant at partial load, and the efficiency of transmission may thus actually increase under such conditions. In an average size of railroad shop plant a resultant all-day efficiency of 65 per cent. from the engine to the motor pulley may be assumed.

Shafting Efficiency.—The average friction horse-power in heavy machinery shops to drive belts and shafting, from engine to tool pulleys, as given by various authorities, varies from 40 to 55 per cent. of the total power used, and perhaps the round figure of 50 per cent. is as near the correct general average as the data will permit. Considering a separate shaft only, with compactly arranged tools, a better efficiency than the above can be assumed, and the committee concludes from a number of experiments with electrically-driven line shafts that 20 per cent. fairly represents the average loss in shaft and counter-shaft bearings and belts on the tools, or an efficiency of 80 per cent. Some authorities attempt to express the actual horse-power lost in friction per 100-ft. length of shafting and per counter-shaft and per belt, but while figures of this kind would be useful if approximately correct even, the committee has been unable to check them closely enough to feel warranted in quoting them.

As a rough guide in laying down shop power plants, it would appear that the horse-power of generating station required per man for railroad shops will average about .4 horse power.

Table No. 1 (shown on the opposite page) gives a few examples from tests of the power required to drive typical railroad shop tools, both for iron and wood-working. The greater number of these results for metal-working tools were taken from tests at the Baldwin Locomotive Works, and for wood-working tools from Pennsylvania Railroad Company's tests.

Suggestions Upon the Manner of Installing.

System.—Both direct and polyphase alternating current systems are applicable for shop use, and each system has its advocates among electrical engineers.

For long-distance transmission, say one mile or more, alternating transmission is almost a necessity; for shorter distances, and in cases of isolated plants in compactly grouped railroad shops, the direct current system can be employed without any practical disadvantages in waste of power in transmission lines. Mechanically, the induction type of alternating motor has great advantages in its simplicity and the absence of rubbing contacts. When it is said that probably 90 per cent. of all direct-current motor repairs are to commutators and brushes, the importance of this statement is clear. A further advantage in the induction motor is the strong mechanical design of the revolving element. This is built up of heavy copper bars firmly bolted to a cast center. The direct-current motor, on the other hand, is a complicated assemblage of small wires, made additionally weak by the necessities of insulation. The disadvantages of the alternating-current motor are its high speed and the fact that it is essentially a constant speed machine. For driving line shafting, a constant speed motor is entirely satisfactory, but for independent tool driving a variable speed motor has unquestionable advantages. If the alternating system is to be adopted, it is important to specify that the motors shall be of the "induction" type, as this is the only variety which is at all applicable for shop uses.

A further element of importance in the alternating system is that of "frequency" or number of alternations of the current per minute. It is difficult to give a positive recommendation as to the proper frequency without qualifications. Realizing, however, the importance of standardizing apparatus, the committee venture to suggest the specification of "3,000 alternations per minute" for adoption in railroad shop plants. Alternating motors

of this frequency are now in general use and have the very great advantage of fairly slow speed.

Voltage.—Direct-current generators are built for 125, 250 and 550 volts pressure, which, allowing for ordinary losses in lines, corresponds to motor pressures of 110, 220 and 500 volts respectively. The 220-volt direct-current motor is practically the standard for shop purposes; the 550-volt motor is used for railroad purposes, but this pressure is undesirably high for shop use. Incandescent lamps may be obtained for 220-volt circuits, or the more common 110-volt lamp may be used on such circuits by connecting two of them in series. A 250-volt generator, together with 220-volt motors, are therefore recommended for shop plants. Alternating-current motors are wound for either 220 or 440, and for similar reasons to the above, the 220-volt system is recommended.

Type and Size of Generator.—As between the direct-connected and belted machines the relative advantages may be thus stated: The direct-connected generator is more compact and more solid in construction, especially in small machines, due to the greater size of its parts. It is therefore more durable and somewhat more efficient on account of elimination of frictional losses in belting.

The belted generator has an advantage of cheapness in first cost, due to its higher speed, which means more output for the same amount of material; and the further fact, often of importance, its ready applicability to existing engine plants. For generators of 75-horse-power or less, the belted machine answers every practical purpose, but above this size the purchase of direct-connected machine will be found an economy in all new plants.

In planning the installation of a transmission plant with small beginnings for running, say, one electric traveling crane, transfer table, turn-table outfit and a few portable tools, a 75 or 100 horse-power belted generator will be found a convenient unit size. It may be installed cheaply by belting from the counter-shaft at the main shop engine, but it is altogether better to provide a separate engine, for the reasons that the electric drive may be needed twenty-four hours in the day for special work (such as roundhouse turn-table), and it makes a good emergency power plant for portions of the shops working overtime. It may be also used at nights to light the roundhouse and other buildings. When the transmission plant outgrows the capacity of this generator, it may still be used as a "spare" or for overtime work.

In laying out a complete system of electric transmission to displace engine and shafting transmission, careful attention should, of course, be given to selection of unit sizes. Little advice can be given offhand for such a case, as the determination of average and maximum loads is the basis of all calculations. In large plants, say of 500 horse-power or over, there should be two, and possibly three, units of the direct-connected type and selected so that the engines shall run as far as possible at economical loads, and that one unit may be out of service for repairs.

Calculation of generator capacity required can be made approximately from published data on power required to run machine tools. It is usual to install motors having a considerably larger nominal capacity than figured requirements, so that generator capacity need never be as great as the added capacities of motors attached. In fact, the generator load in an ordinary shop seldom runs above 50 per cent. of that of the combined motor capacity, and in shops having a large motor load the effect on generator of running a traveling crane, a transfer table and turn-table need not be considered, as the momentary overload capacity of the machine will be ample to take care of such requirements.

Rating of Generators.—Generators are sold with a guarantee to deliver their rated capacity, when driven at a certain speed, indefinitely, with a maximum temperature rise, due to electrical losses, of an amount supposed not to be injurious to insulation. This rise should not exceed 40 degrees centigrade above the temperature of the surrounding air. They are also guaranteed to carry an overload of 25 to 50 per cent. for two hours, and short-period overloads of 100 per cent. without injurious heating. These guarantees have led to an objectionable but common practice of figuring the engine size on the overload capacities; that is, it is quite customary to couple a generator to an engine having its economical rated capacity equal to the 50 per cent. overload capacity of the generator. The consequence is that load is piled on the generator as long as the engine will pull it without seriously dropping off in speed, and an expensive generator is finally ruined for lack of the common-sense precaution which would be furnished by a properly adjusted engine unit.

Motors.—If the direct-current system be adopted, a wide range of selection in motor types is possible.

For line-shafting, motors should be of the shunt type. For individual tool driving, the shunt motor is also in most common use; but the compound-wound variable speed motor is recommended as a desirable substitute. In fact, it is the belief of the committee that one of the great advantages of electric driving is in the possibility of simple speed regulation for large tools, and the attention of the electrical companies should be called to the importance of filling this requirement in their line of standard motors. Motors are preferably of "open" construction; that is, with the ends of field frame uncovered. Where exposed to the wet or to mechanical injury from articles falling into it, the closed type of motor may be employed, but this type is not desirable where it can be avoided on account of its lack of ventilation, which means overheating unless the motor is of relatively large size for the work to be done.

For traveling cranes, hoists, transfer tables, locomotive turn-tables and boiler shop plate rolls, which start under load, run at variable speed, stop and reverse, the series-wound motor is the best, and is preferably of the enclosed style, which allows of more universal connection in any position, by gearing or otherwise, than the open-type, and the question of heating is not so serious, on account of intermittent running.

For alternating motors, the same considerations as for the "direct" apply; but, as elsewhere explained, variable speed running in this type for tool-driving motors is not practicable. For crane work, however, the induction motor is successfully applied by attaching special controlling devices.

In selecting motors, the importance of keeping down the number of sizes should be had in mind. This should be done at the expense of some increase in first cost and in spite of some waste of power due to reduced efficiency of underloaded motors, especially as their reliability is thereby enhanced. Competition among the makers of cheaper grades of motors has resulted in giving ratings dangerously close to the maximum safe working limit, and with all motors a reduction in the working load greatly increases their durability.

In deciding upon the make of motor to be purchased there is the same range for selection as found in other lines of machinery; but as an electric motor is a somewhat delicate machine, it is important to select only those made by reliable manufacturers. Such can be had of several companies, but they are not the lowest in first cost, and, in absence of definite information, it is generally safest to avoid very cheap machines. Even the best manufacturers make motors with different ratings as to speed and heating limits, and the lowest speed and lowest heating limit motors should be selected. This latter should not exceed 40 degrees centigrade rise above external temperature at continuous full load run. The speed should be the so-called "slow-speed" variety. Table No. 2 gives about the proper speed for each of the standard sizes of shunt motors. It also gives the approximate selling prices of the list, based upon the highest grade machines; price includes motor, with pulley, base-frame and belt-tightener, and starting box.

A corresponding list of "medium-speed" motors may be obtained, the speed for a given power being about 50 per cent. higher than given in the table, the prices being about 20 per cent. less on smaller and 35 per cent. less on larger sizes.

TABLE NO. 1.—POWER REQUIRED FOR MACHINE TOOLS.

Tool.	Nature of Work.	Horse Power Required. Empty.	Light Load.	Full Load.	No. of Cutters.	Remarks.
70-in. wheel lathe	Wheel center	...	4.4	7.9	2	Light cut.
	32-in. wheel center	...	4.7	5.8	2	½-in. deep cut.
	56-in. wheel center	1.5	5.2	6.2	2	
Horizontal lathe	56-in. wheel center	...	4.3	7.1	1	½-in. deep cut.
Large double frame planer	Two frames	11.0	...	21.6	2	½-in. deep cut.
Slotter, 18-in. stroke	Frames	2.3	5.0	10.3	1	Heavy cut.
Slotter, 12-in. stroke	Wrought iron, 6 in. thick	1.5	2.1	6.5	1	
36-in. planer	Frames	3.4	4.2	7.4	1	
		3.4	...	11.3	2	
Drill press	1-in. drill, wrought iron	.97	1.94	2.9	1	
	1½-in. drill, wrought iron	.97	1.92	2.2	1	
	2¼-in. drill, wrought iron	.97	1.94	2.85	1	
Boiler-plate shears	9-16-in. plate steel	3.5	6.0	19.0	1	
Boiler-plate rolls	11-16-in. by 10 ft. 6 in. long, steel.	4.5	14.4	19.8	..	
Jib crane, 10 ton, 10-h.p. motor	Lifting 10 tons	1.2	...	13.0	..	
	Lifting 7 tons	1.2	...	11.0	..	
Jib crane, 6-ton, 8-h.p. motor	Lifting 6 tons	1.2	...	11.6	..	
Traveling crane, 5-ton	Lifting and carrying 4 tons	11.9	...	19.3	..	
Planer	Empty	3.4	...	...	..	
	1 tool	...	...	7.4	..	
	2 tools	...	...	14.0	..	
Shafting	Empty	15.0	...	...	..	
	6 planers	...	...	20.0	..	
	4 milling machines	...	...	26.0	..	
	2 lathes	...	...	30.0	..	
	1 buff wheel	...	...	34.0	..	
Planer and siding machine	6-in. oak flooring	8.0	...	32.0	..	Top and sides planed.
24-in. planer	12-in. yellow pine	2.5	...	11.0	..	Top only.
Molding machine	6½-in. yellow pine carlin	1.5	...	8.5	..	4 sides.
Daniel 30-in. head planer	Oak tender end sill	3.7	...	8.8	..	Cut 3-16 in. off top.
Three-spindle boring mill	Oak, 2-in. bitts	0.5	...	2.5	..	
Large tenoning machine	Oak end sills	3.0	...	7.0	..	3¾-in. x 5-in. x 10-in. cut.
Circular rip saw, 28 in. diam	Oak, 9¼-in. by ¼-in. cut	1.5	...	20.0	..	
Band saw blade, 1½ in. wide	Oak, 12-in. thick	1.5	...	6.0	..	

Table No. 2—Speed and Prices of Slow-Speed Direct-Current Multipolar Motors.

Rated Output H. P.	Speed R. P. M.	Price.	Price per H. P.
2	1,200	$135	$67
3½	1,050	190	55
5	950	240	48
7½	850	310	41
10	750	400	40
15	650	500	33
20	600	600	30
30	575	850	28
40	550	1,050	26
50	550	1,200	24

Manner of Tool Driving.—This varies in accordance with the motor arrangement and may be by

(a) The group system.

(b) The individual system.

The selection of one or the other system depends upon the size of the tools and the consideration of intermittent or continuous running. In general, where the tools require less than three horse-power each, it is best to drive them in groups from short-line shafts, which, as a rule, should not require more than 25 horse-power per shaft group. Where, however, three horse-power or over is required, or where variable speed or intermittent running is desirable, each tool should have its own motor. In the group system the motor may be either belted to or direct-connected on the end of the line shaft, accordingly as space or plant cost permits. In individual driving either belted or geared motors are employed. The belted arrangement is somewhat clumsy, but reduces shock and prolongs the life of the motor, and is, in the opinion of the committee, the better arrangement for general use.

Conclusions.

1. In a small shop, consisting of practically one building, having an equipment of small tools for light work only, electric transmission will not be found a paying investment. In such a shop, however, an electric lighting dynamo will be a convenience, and may be utilized to run a few labor-saving electric tools, such as a cylinder-boring outfit, a turn-table motor, etc.

2. In an extensive railway shop plant the installation of a central power station and electric transmission will always be found advisable, as ti will not only result in the most economical system in respect to operation, but will make possible far more important shop economies, namely, an increase in quantity and quality of output and a reduction in cost of handling the same.

In Appendix A are descriptions of electric apparatus and in Appendix B are descriptions of noted electrical installations, at the Westinghouse Air Brake Works, Oelwein Shops of the Chicago Great Western, General Electric Company and Baldwin Locomotive Works.

This report is signed by George Gibbs, chairman; F. Mertsheimer, William Renshaw, W. A. Nettleton and R. A. Smart.

BEST TYPE OF STATIONARY BOILERS FOR SHOP PURPOSES.

This committee received a number of answers to a circular letter which show that there is a wide difference of opinion as to the relative merits of return tubular boilers, water-tube boilers and locomotive type boilers for shop purposes, and it was not able to get sufficient data to make any definite recommendation. The advantages and disadvantages of the various types were discussed, however, and it was suggested that if the subject be continued another year, tests be made of the water-tube boilers at Purdue University. Also, that tests be made of a battery of return tubular boilers of similar capacity.

This report is signed by J. F. Dunn, J. J. Ryan and John Hickey.

WHAT CAN THE MASTER MECHANICS' ASSOCIATION DO TO INCREASE ITS USEFULNESS?

The committee sums up its suggestions as follows:

A nomination of officers by a nominating committee.

An improved method of admitting associate members.

The taking of record votes on questions of practice.

More preparation for the introduction of discussions, and more complete plans for their consideration.

The abolition of the universal practice of appointing as chairman of a committee the member who suggests the subject for committee investigation to the committee on subjects.

Recommendations to the President by the committee on subjects of members best qualified to present them.

Committees of investigation composed of small numbers of individuals.

Provision for the reception of individual papers.

Strict adherence to the rule requiring the presentation of long papers by abstract.

The co-operation of railway clubs and special organizations in the presentation of opinions on practice, and in the suggestion of subjects for investigation.

More explicit instructions to committees as to arrangement, and advancing conclusions in reports.

The appointment of several additional standing committees on subjects concerning motive power progress.

Increased responsibilities of the committee on subjects in the actual work of the convention.

Provision for a thorough printed index of the proceedings of the Association from the first volume.

An effort to make the reports presented to the Association thoroughly reliable.

A typographical arrangement of reports which will render the conclusions and decisions more easily found.

The establishment of a library similar in plan to that of the Western Railway Club.

This report is signed by T. R. Browne, G. M. Basford and L. R. Pomeroy.

THE EXTENT TO WHICH THE RECOMMENDATIONS OF THE ASSOCIATION HAVE BEEN PUT INTO PRACTICE.

As a preliminary to this report, the committee sent out a letter of inquiry, dated February 28, 1900, accompanied by an alphabetical and classified index of all the subjects dealt with in the reports, papers and discussions, during the thirty-two years of the Association's existence. These indices are thought to be of permanent value to members of this Association and will, therefore, be included as part of the final report of the committee. As a result of this letter of inquiry sent to upward of 600 members, the committee only received four replies, and, therefore, prepared a second circular of inquiry, which was sent out under date of April 30, 1900. At the date of this writing the committee has received 23 replies to the circular sent out and the 77 questions propounded have been replied to by most of those sending in answers. In order to record the form in which the questions were put the greater part of this second circular of inquiry is appended to the report and after each question is a summary of the replies received.

It may be stated that in round numbers the total number of circulars or inquiries sent out was 600. The total number of individuals making replies was 23, the number of different railroads represented in the replies was 21, and the number of locomotives owned by the roads represented in the replies was 6,347. The number of locomotive builders represented in the replies was 1 and the number of Mechanical Engineers and others not in railroad business making replies was 1.

The committee does not feel that from so small a number of answers out of so large a membership it would be proper to draw final or affirmative conclusions, but certain negative conclusions can at least be drawn. It is found that the recommendations of the Association have been unanimously approved by those answering this circular in only 7 cases. They have been approved with a small minority against it in 27 cases. They have been disapproved by a large minority and in some cases even a large majority in 32 cases, while in the remaining 12 cases the opinion is too varied to classify.

This report is signed by F. A. Delano, Chairman; A. Sinclair and H. Middleton.

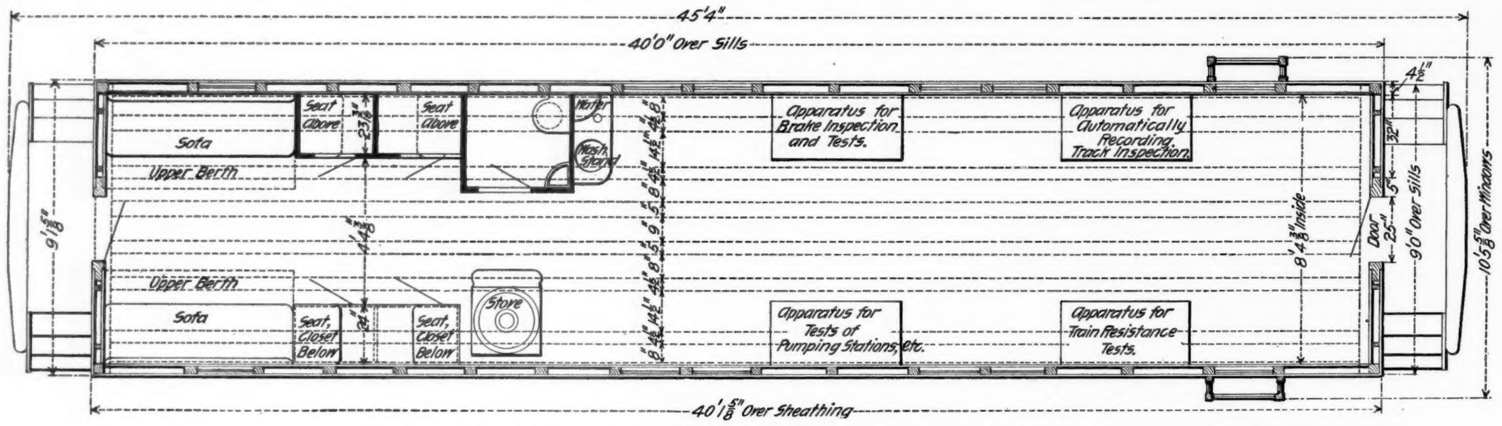


Fig. 1.—Plan of Test Car—Illinois Central Railroad and University of Illinois.

Test Car of the Illinois Central and the University of Illinois.

BY EDWARD C. SCHMIDT.*

The test car here described is now being built at the Burnside Shops of the Illinois Central at Chicago, and will probably be completed and ready for operation about July 1. It will be owned and operated jointly by the Illinois Central and the Railroad Mechanical Engineering Department of the University of Illinois, the car being built by the former and the apparatus and other equipment by the latter. The car is designed for general railroad experimental work, and will be adapted for the following purposes, for each of which it has its special equipment: Measurement of train resistance; automatic track inspection; locomotive road tests; air-brake tests and station tests. Hydraulic transmission of the pressure and motion has been adopted for both the apparatus for dynamometric work and for track inspection. The latter, however, is not being at present installed. The car has been designed under the direction of Mr. Wm. Renshaw, Superintendent of Machinery, Illinois Central; Professor L. P. Breckenridge, of the Department of Mechanical Engineering of the University of Illinois, and the writer.

The car itself has been specially designed for this work, and the plan is shown in Fig. 1. It has been built particularly heavy, in order to withstand the usage it will receive in the heaviest freight service. It is 45 ft. 4 in. long and 40 ft. over the end sills, which is as long as is compatible with the necessary stiffness and rigidity. It is 8 ft. 4⅜ in. wide inside, 9 ft. 1⅝ in. outside, with an extreme width of 10½ ft. over the observation windows. About 15 ft. in the rear end is occupied by the berths, lockers, closets and toilet-room, leaving 25 ft. working space in which are placed the tables and instruments. The lookout shown in the rear of the car affords facilities for observing the handling of the train, and in it are placed the push-buttons controlling the signals to the operators below, and also the pens which mark on the dynamometer record the location of mile posts, stations, curves and grades. The projecting windows at the front end also provide a means of watching the train and engine.

The next three engravings show the general arrangement and some of the details of the apparatus used in experiments for the measurement of train resistance, which constitutes at present the more important part of the equipment, the track inspection apparatus not being designed as yet. Fig. 2 is a diagram showing the various parts of the apparatus in their relations to one another. The pressure due to the pull on the drawbar is taken in a cylinder filled with oil, and this pressure is transmitted thence by the oil to the recording and indicating gages in the car above. The record of the amount of drawbar pull is made on a continuous strip of paper

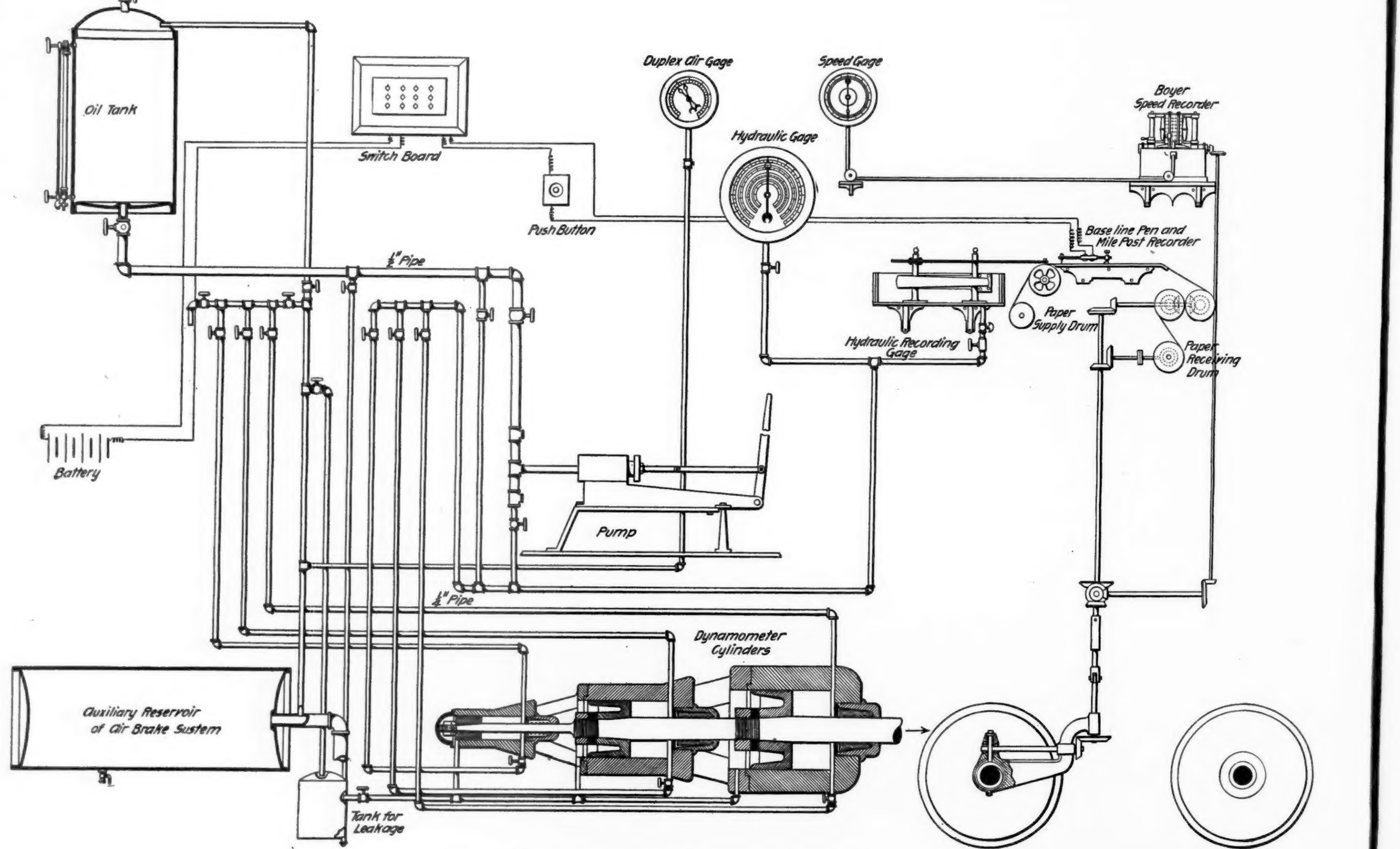


Fig. 2.—General Arrangement of Apparatus in Test Car.

*Instructor in Railroad Engineering, University of Illinois.

6 in. wide, which is drawn past the marking pen on the recorder at the rate of 13.2 in. per mile. This paper is driven from the car axle, as indicated, and upon it are marked, in addition to the curve showing the pull on the drawbar, the location of mile posts and stations and also time. The mile-post pen, which is controlled by electro-magnets, draws a continuous line, and at mile posts and stations is drawn slightly aside by these magnets, which are operated from a push button touched by the observer in the lookout. The pen recording time is similarly made, and is automatically controlled by a clock which makes electric contacts every 5 or 10 seconds, as desired. A speed record is also obtained upon a separate chart in the speed recorder shown at the right.

The oil pump receives its supply from the oil tank, and by properly arranged piping forces it into the three cylinders of the dynamometer. Compressed air, taken from the auxiliary reservoir of the air-brake system, is used to clear the oil from the cylinders when necessary, and also to aid in filling them and to blow back from the leakage tank whatever oil leaks by the pistons and stuffing boxes of the three cylinders. From the switch-board electric connections are made to the various signals and pens, to the revolution counter in the car, which shows the revolution of the driving wheels, and also to the electric signals for indicator cards at the front end of the engine.

The dynamometer cylinders are shown in Fig. 3. They are made in three castings held together by stud bolts not shown in the drawing. The effective area of the largest cylinder is 60 sq. in., of the second 30 sq. in., and of the smallest 5 sq. in. It is intended that the working pressure of the oil in the cylinders shall be from 300 to 1,000 lbs. per sq. in., and for this range of pressures the first, or largest, cylinder has sufficient capacity for the heaviest freight service. The intermediate cylinder will be used when working with a train of ordinary tonnage, while the smallest will be used for passenger service. In this last case the working pressure may be somewhat higher. If it should become necessary the largest and the intermediate cylinders could be coupled up in tandem, thus giving an effective piston area of 90 sq. in.

The piston rod is connected to a drawbar yoke of special design, and is so arranged that when the piston travels too far forward and beyond its working position, the pull is taken on the springs of the ordinary draft rigging. Pushes on the rod are likewise received immediately upon these springs. An electric "tell-tale" arrangement notifies the operator when the piston passes its proper limits on account of the leakage of oil.

The cylinders are reamed, the pistons ground, and the piston rod ground where it moves through the stuffing boxes. The stuffing boxes were designed particularly for this arrangement, and consist essentially of the inner sleeve or gland, which is ground internally to fit the rod and grooved, as shown, to help retard the leakage. The forward end of the gland is ground spherical, and fits into a ground spherical seat in the stuffing box casting. This spherical seat is used to permit the three sleeves to align themselves properly on the road. The pressure of the oil keeps the gland on its seat, and this oil pressure is supplemented by the pressure of several helical springs placed between the rear end of the sleeve and the plate shown at the inner end of the stuffing box.

Considerable difficulty was experienced in making the joints between cylinder and pistons and between stuffing box and rod sufficiently good to prevent undue leakage; but this has now been accomplished, and the leakage under the upper limit of the working pressure, i. e., 1,000 or 1,200 lbs. per sq. in., is not sufficient to in any way interfere with the proper working of the apparatus. The pistons will move forward on account of the leakage, but so slowly that the cylinders can be refilled from the pump at stops, or, if necessary, when the cylinders are under pressure. This design was resorted to in order to avoid the uncertainty concerning the frictional resistances incident upon the use of the usual packed pistons and stuffing boxes. The cylinders have been calibrated, in connection with their gages, upon an Olsen testing machine, and the total pull on the rod necessary to overcome the friction in the apparatus has been found to be about 30 lbs. The cylinders are secured to the draft timbers by flanges shown at the sides and top.

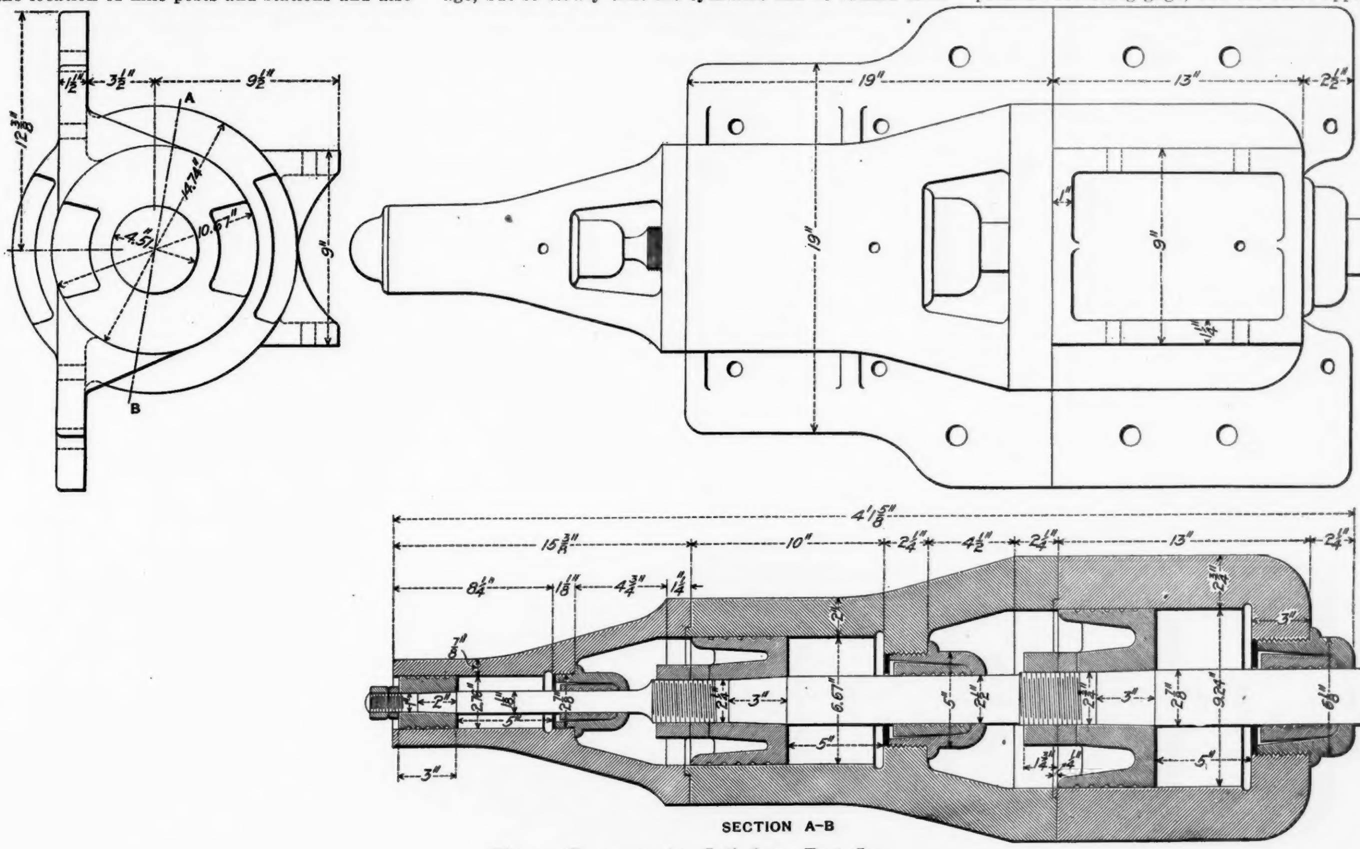


Fig. 3.—Dynamometer Cylinders—Test Car.

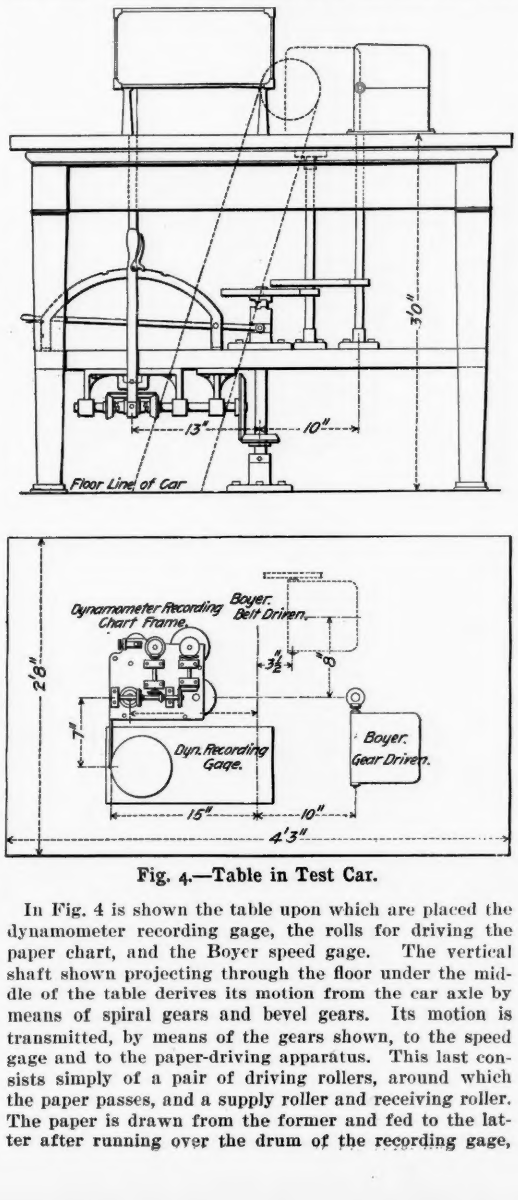


Fig. 4.—Table in Test Car.

In Fig. 4 is shown the table upon which are placed the dynamometer recording gage, the rolls for driving the paper chart, and the Boyer speed gage. The vertical shaft shown projecting through the floor under the middle of the table derives its motion from the car axle by means of spiral gears and bevel gears. Its motion is transmitted, by means of the gears shown, to the speed gage and to the paper-driving apparatus. This last consists simply of a pair of driving rollers, around which the paper passes, and a supply roller and receiving roller. The paper is drawn from the former and fed to the latter after running over the drum of the recording gage, also shown at the left. In addition to this apparatus the car is equipped for locomotive road tests with gages for indicating and recording boiler pressure and steam-chest pressure, duplex air gage, air-brake train line pressure recording gage, and the other apparatus used in locomotive tests. The track inspection apparatus and other apparatus are to be installed as soon as needed.

The Master Mechanics' Convention.

The thirty-third annual meeting of the Master Mechanics' Association was opened Thursday morning, June 21, at Saratoga, N. Y., following the Master Car Builders' convention, reported last week and in this issue. The President, Mr. J. H. McConnell, of the Union Pacific, called the meeting to order and an address of welcome was made by Mr. A. J. Pitkin, Vice-President of the Schenectady Locomotive Works. In the President's annual address, Mr. McConnell referred to the satisfactory condition of the Association, as would be shown by the Secretary and Treasurer when he proceeded to review the chief events of the year. Some extracts from this address follow:

EXTRACTS FROM THE PRESIDENT'S ADDRESS.

The report of the Interstate Commerce Commission shows, on June 30, 1898, 36,234 locomotives in service. The increase in two years would indicate about 37,000 in service at the present time on 189,236 miles of railroad. During the year 1899, 2,196 locomotives were built in the United States, costing about $25,000,000. One thousand seven hundred and sixteen were delivered to American railroads. Four hundred and eighty were shipped to foreign countries, 70 per cent. of the foreign orders being sent to Europe, Asia and Africa, 30 per cent. to Mexico, Canada, South America and the West Indies. Of the entire output of American locomotives 21.4 per cent. were foreign orders. The year 1899 has been a year of large locomotives. Reports for the year show four types of freight locomotives having a weight of 218,000, 225,000, 230,000 and 232,000 lbs. respectively, with a weight on drivers of 193,000, 198,000, 202,000 and 208,000 lbs.; heating surface 3,203 sq. ft., 3,322 sq. ft., 3,500 sq. ft. and 4,105 sq. ft. One with cylinders 23 x 32 in., two with cylinders 23 x 30 in., and one compound with cylinders 18 and 30 x 30 in.

Locomotive tenders were built with water capacity of 7,000 gallons. A number of roads have made 5,000-gal. tanks their standard, while others have adopted a 6,000-gal. tank. The use of cast steel in locomotive construction has increased very largely. During the year 1899 a number of engines were constructed, showing an increase of 33 per cent. in the use of steel castings over three years ago.

Nickel steel has not come into very general use. Mechanical departments are advancing cautiously in this direction. The use of piston valves has increased in the last year. On simple engines improved forms have been introduced, and having passed the experimental stage we may look to see them advance rapidly in favor. The past year has shown the most rapid advance in weight on driving wheels, tractive power and increased heating surface of our locomotives.

The tendency is all in the direction of increased tonnage in freight trains. Large sums of money are being spent by trunk lines in cutting down grades and reducing curvature in order to reduce the cost per ton mile for handling freight. The constant tendency of a decline in freight rates can only be offset by the increased power

of the locomotive. In passenger service the same development of the locomotive has taken place as with the freight engine. A few years ago 80,000 lbs. weight on the driving wheels of an eight-wheel locomotive was considered excessive. It has now reached 94,000 lbs. on an eight-wheel locomotive. In passenger service ten-wheel locomotives are being built, with 130,000 lbs. weight on the driving wheels and a heating surface of 2,500 sq. ft. The passenger service throughout the country has increased in the weight of trains as well as in speed. With the large locomotives in service when compared on a mileage basis, the cost per mile for fuel, repairs and lubrication shows an increase. Compared with several years ago on the tonnage basis the cost per ton mile for repairs, fuel, oil and other supplies is largely in favor of the recent locomotive. The compound locomotive is gradually gaining in favor. During the year 1899, 330 engines of this class were built in the United States.

The improvements during the year have not all been confined to locomotives. Shop practices have advanced to a marked degree. New shops are now largely supplied with electricity for driving machinery and it is displacing the stationary engine and line shafting. New tools electrically driven are coming into general favor and the economy of such machines can not be questioned. Compressed air has found its way in all shops both large and small. The air compressor is of as much value in the railroad shop to-day as the stationary engine. The manufacturers of compressed air tools have brought out new designs and by their use the work is performed more economically. The modern shops are supplied with both electricity and compressed air. Both have their advantages and neither can displace the other on certain lines of work. For driving machinery electricity is more economical and superior to the old line shafting and stationary engine. For small tools compressed air is superior to electricity and more economical.

Secretary Taylor then read a letter from the Schenectady Locomotive Works inviting the members of the Association, and their friends, to inspect the Works during the convention at Saratoga and saying that a special train would be provided and lunch furnished at the Works. On motion, it was decided to accept the invitation; further, that the Association would visit Schenectady on Friday afternoon.

The report of the Secretary showed a total membership of 665, distributed as follows: Active, 620; Associate, 19; Honorary, 26; an increase of 12 members during the year. The announcement was made relative to the scholarships of the Association at the Stevens Institute of Technology that no applicant had appeared at the June examination. A vacancy will exist in one of the scholarships in September. The Treasurer reported a balance of $3,468.63 on hand. It was decided that the annual dues for the coming year should be $5, the same as last year.

WHAT CAN THE MASTER MECHANICS' ASSOCIATION DO TO INCREASE ITS USEFULNESS?

The report was received and the resolutions of the Committee were adopted.

President McConnell—I understand that it will cost about $500 for the compilation of the index, independent of the printing, and we have something like $3,300 in the treasury. I will appoint as a committee on the first resolution, which is to consider the suggestions made in this report and present later in this convention, recommendations for such changes in the Constitution as may be necessary to carry them into effect, Messrs. Robert Quayle, S. M. Vauclain and H. A. Gillis. I will appoint as a committee on the second resolution, which will have full authority to act in the preparation of a complete printed index of the Proceedings of this Association from the first volume to date, Messrs. F. A. Delano, S. P. Bush and C. M. Mendenhall.

TOPICAL DISCUSSIONS.

Nickel-steel as a journal bearing. Is there any noticeable increase in friction or wear, as compared with the ordinary steel or iron?

Mr. W. Lewis (Norfolk & Western)—As you know, we have had some disappointing experiences with low carbon steel, and we have gone to the other extreme as far as that was safe. We have used a steel for driving axles, piston rods, etc., that was up as high as 0.40 and 0.45 per cent. in carbon. The well known toughness of the nickel-steel has prompted the belief that it might be a more suitable material for driving axles, etc. The best evidence whether the metal is a good bearing metal is in the fact whether or not it will take a high polish in service. After a little more than a year's experience with the nickel-steel, there is nothing I have discovered that would lead me to believe it is not a good bearing metal or that there is any excess of friction.

Mr. S. M. Vauclain (Baldwin Locomotive Works)—I regret very much that I am unable to give you any experience in the use of nickel-steel on locomotives after they have been put in service. I might, however, enlighten the members upon the character of nickel-steel as it appears during the course of locomotive manufacture. It is my belief that nickel-steel, properly made, is probably the best material in steel that can be used; but I would caution the members to be careful as to the exact quality of the material which they may purchase, or which may be sold to them, as nickel-steel. We have found that a great amount of it is somewhat imperfect. The surface is full of small seams running longitudinally with the material and causing quite a number of rejections. This was especially true in the early days of nickel-steel. Considerable controversy and research was had in the matter, and considerable improvement has been made in forgings that have been supplied to us as nickel-steel forgings. I wish to say that nearly, if not quite all, the forgings now shipped to us for locomotives that we have under construction seem to be perfect, almost perfect, in that respect, and rejections are very few. I can see no reason for those who are inclined to pay the extra price for nickel-steel, why it should not be used in the construction of high-class locomotives.

Mr. Robert Quayle (Chicago & Northwestern)—I think what was intended to be brought out in this discussion is whether or not any difficulty has been found with this steel heating; if it generated more heat than the ordinary carbon steel? I must say that we have some locomotives that are equipped with nickel-steel and we found one or two of our locomotives with the nickel-steel driving axles heating, but we do not know whether it was due to the steel or some local cause. Some people I have talked to have concluded that nickel-steel does develop more heat than the other steel.

Mr. H. A. Gillis (Richmond Locomotive & Machine Works)—The government is using nickel-steel to a large extent in marine engines, and in such service as torpedo boats and destroyers, the engines of which are run at high speed and under conditions which necessarily require that the best material, and the material which will give the least trouble from heating, must be used.

Mr. F. A. Delano (Chicago, Burlington & Quincy)—It seems to me in Mr. Lewis' remarks there is some confusion between a bearing metal and a metal borne. I question from the information I have been able to get that the best bearing metal is one which takes the highest polish, or which is the most homogeneous, or which is the most dense. There seems to be strong evidence that a good bearing metal must be somewhat porous and crystalline, and have crystals of different structure embedded in it, and that a homogeneous bearing metal which will take a high polish might not make a good bearing.

THE EXTENT TO WHICH THE RECOMMENDATIONS OF THE ASSOCIATION HAVE BEEN PUT INTO PRACTICE.

Mr. G. R. Henderson (Chicago & Northwestern)—The Committee has done so much work in preparing the index which was sent out with the original notice, and which was of so great interest and value to all of us that in accepting the report we ought to go further and express our appreciation of the work of the Committee. Such a motion carried, and the Committee was discharged.

RELATIVE MERITS OF CAST-IRON AND STEEL-TIRED WHEELS.

Mr. G. W. Rhodes (Burlington & Missouri River)—I might say a word or two, as I am put down as being one of the few members who replied to the circular. When I see this report printed here, it looks a little bald, and I am afraid that possibly some of the members may wonder why I should have so much confidence in cast-iron wheels. One of the dangers in cast-iron wheels is the application of the brake shoes to the wheels and the heating of the surfaces of the tread. When the thermal test of the M. C. B. Association was first adopted, the manufacturers in some cases objected to the thermal test. But a matter came recently to my attention which surprised me. Some of the foundries that we bought wheels from rather objected to the thermal test, and when we subjected their wheels to the thermal test, we found they would not meet the requirements of the test. But when we got out in the Western country, where the wheels are run in the mountainous districts, without requiring any thermal test we found that the foundrymen in that locality made wheels which stood the test. I asked a foundryman the reason for it. He said, "In this country where brake shoes are applied so much with air-brakes, we could not sell wheels if they did not stand hating from applying the shoes." That showed that actual practice had made the foundries in the West produce wheels more susceptible of severe braking than in the East. We have been buying wheels on the Burlington road for the last two years under the thermal test, and I cannot find a broken cast-iron wheel, which has been cast in the last two years. It is largely on account of that fact that I express myself so strongly. What I have more especial reference to is that it is not so important on the grades, as they have been cared for, but it is important on the level roads on account of the general way in which we are applying air-brakes to all of the cars.

Mr. G. R. Henderson—In the report it is stated that Mr. Rhodes is of the opinion that 33-in. cast-iron wheels made to the M. C. B. standard test, is a safer wheel than some of the steel-tired wheels on the market. I would ask Mr. Rhodes what points he has in view? Is it the loosening of the tire on the wheels from the braking, or what is the difficulty that he finds with the steel-tired wheels?

Mr. G. W. Rhodes—What I have reference to is that cast-iron wheels will crack in the plate, and will break if they are not detected and removed. With some of the wheels with steel tires we have had the same thing occur. The spokes will crack, and if they are not detected and removed, the wheels will break. The tires will also crack and break. That is the reason I gave the opinion I did.

A motion that the Committee be continued another year, carried.

TON-MILE BASIS FOR MOTIVE-POWER STATISTICS.

Mr. H. J. Small (Southern Pacific)—My name was signed to this report with a certain protest. I really do not agree in all that the report contains. Mr. Marshall, the third member of the Committee, also did not agree with some of the recommendations, and declined to sign the report. Mr. Quereau would include in the ton-mile statistics all car service, freight, passenger, work and switching. Personally, I am in favor of covering only freight service, on which we get the benefit of the ton-mile. The passenger service is somewhat beyond the control of operating officers, although it could be, perhaps, brought in under the ton-mile basis to some extent; but switching and work service seem to be entirely outside of that matter, on which definite data could be obtained.

Mr. G. R. Henderson (Chicago & Northwestern)—I do not agree entirely with the method proposed of including the weight of the engine and tender in the work done per ton-mile per pound of fuel or per pint of oil, and I think that we ought to consider the work actually done back of the tender as the unit to be adopted. If we can produce an engine with the same tractive power, of lighter weight, the engine is entitled to the benefit of the extra ton-mileage it will make.

Mr. W. H. Marshall (Lake Shore & Michigan Southern)—As a member of the Committee I did not feel that I could sign this report, and I regret being put in this position, because I believe thoroughly in ton-mileage statistics, but it seems to me the report of the Committee goes altogether too far. Again, in the conclusions and recommendations of the Committee we are asked to include in the ton-mileage to be used by the motive power department, the entire weight of the train. It seems to me that the members of this Association have, in a certain sense, a dual task. They may be interested, and ought to be interested, in the performance of locomotives from a scientific and expert view. But there is another side which compels them to look upon it in exactly the same light that the management does. The essential thing to a railroad company is what an engine does behind the tender. In the body of the report the argument is made that the engine should be credited with all it does, and, furthermore, the work behind the tender is not of particular advantage to any one, because when the Transportation Department begins to consider these figures it must consider the net revenue load. I do not agree with that, either. It seems to me the load behind the tender is one of the most important considerations for both departments. The first thing would be to see that the engines haul what they are supposed to haul. The next thing for the Transportation Department to see is that as large a percentage of that tonnage behind the tender is paying freight as is practicable. I judge from this report it is the intention to put all the items that are involved in engine service on the ton-mile basis, and that basis only. I think if we abandon the engine-mile basis entirely, we lose a valuable comparison for certain items. Make the ton-mileage figures, in freight service particularly, the more important, and the ones by which we will judge of our performance; but use the figures on the engine-mile basis as a side light upon the others. It is practically impossible to obtain the actual tonnage in working train service, but it is comparatively easy to obtain the actual mileage. We are asked to take one figure we cannot get and abandon the other figure we can get, and use an arbitrary mileage per hour instead. In view of the irregularity of work train service, I do not believe it is advisable to do any such thing.

The recommendation for switching engines is to use an arbitrary ton-mileage. The engine-mileage is arbitrary now, and I do not see why we should adopt a second arbitrary mileage. It has occurred to me, in order to put switching engine performances on a ton-mileage basis, we should hold to an engine mile basis and make supplementary figures showing the cost of such service on the basis of the ton-miles made by freight trains over that division. I do not see that these figures would be of much practical value. It is also recommended that the statistics for main line and branches be separated. I believe that should not be recommended, for the reason that conditions vary to such an extent that the recommendation might not be of much value.

Mr. F. A. Delano—There is a very great difference in the methods of keeping statistics, and I think it is true that many motive power officers do not know, in the minute details, just the basis on which their own figures are made up. The making up of these figures has got into such shape that in some cases it is left to some patient and painstaking clerk in the Auditor's office or in the motive power office, who has been grinding out these figures month after month, and when you get right down to the details of how these figures are made up, I believe any motive power officer will be surprised at what he finds. I agree with what Mr. Henderson and Mr. Marshall have said in regard to not including the engine and tender as part of the tonnage of the train, but that does not begin to be the only difference in the basis on which motive power statistics are made. The train mile does not mean the same thing on two roads; the engine-mile does not mean the same thing on two roads, and I venture to say that the ton-mile does not mean the same.

Mr. G. W. Rhodes—The Chairman of this Committee not being present, and the few who have spoken on the subject having taken opposite views to what he has, I feel like saying something which I believe he would say if he were here. The object of these statistics is to obtain better results. If you leave out a portion of the tonnage that helps to consume the coal and the other materials used on the engine, you are not going to be able to put yourself in a position to say that you are entirely fair in your method of measuring. Suppose I am

an engineer, hauling 700 or 800 tons over the division. Business is light one way, and we have to run light, and I get instructions to go 200 miles west with the way car, and I burn coal all the way going those 200 miles, and it is not measured up in my performance. I may have to do that frequently during the month, and my record may compare poorly with an engineer who has not had to haul the engine and car a long distance for which no tonnage is allowed. I believe the Chairman of the Committee would say if you want the co-operation of the enginemen it is very essential that everything that tends to consume the fuel and supplies on the engine should be taken into consideration.

Mr. W. H. Marshall—I want to say a word about this matter of comparison of performances among the men. I have taken the figures on a ton-mile basis, and tried to analyze them to see how much it amounted to when you put the weight of the engine in the ton-mileage figures. I will grant there may be some conditions where it would be important, but on the average I do not think it would be, for this reason. Take, for instance, the coal consumed on a ton-mile basis by different engineers, and separate them into groups as nearly comparable as you can make them, and you will find you have results something like this. Here are a dozen men on a certain division, and they are put in the order of their economy in coal consumption. If you will look at the column for the average tonnage of the trains you will find, if the men are about equally good, the man who is most economical probably has 900 tons for the average of the month, whereas, the one who is most expensive has gone down to 350 tons or 400 tons. In other words, the column showing the economy of fuel and the one showing the average tonnage of the train are just in inverse order; one grows large as the other grows small. I think to put the weight of the engine in these ton-mile figures does not make one per cent. difference. The reason is simply this; a man who has a light train on the average for the month, has been compelled to make high speeds. These other matters, which we can all analyze, have averaged up pretty well during the month, and the light train meant high speed, and that is where the coal has gone, except the irregularities which we find in the men's performances and their individual work.

Mr. J. F. Deems (Chicago, Burlington & Quincy)—One might infer from what has been said that we think these reports do not amount to anything. That is wrong. While it is a fact they may not be strictly accurate, they do good; but the greatest advantage in the report is to get it out promptly. I would much rather have a report by the 6th or 8th of the month, which is a little crude, than to have an elaborate report at the end of the month. If it is issued promptly, it will do more good with the enginemen. It strikes me that if we undertake to bring into that report all of the elements necessary to make it strictly correct, it is going to be issued so late in the month it will not be of much value. That has been my experience at least, in handling ton-mile figures in connection with oil and coal records.

SECOND SESSION—FLANGED TIRES.

Mr. P. H. Peck (Chicago & Western Indiana)—I was the first one in the West that tried flanges on all wheels of six-wheel switching engines. I did that to avoid excessive flange wear on the front drivers, which was continually annoying us. I have been running these switching engines over two years, and have not had any flange wear on the front drivers since; and have not experienced any difficulty in going around the shortest curves in Chicago. There is another factor of safety in using the flange tires, because if the switch engine is derailed, the first thing they do with blind tires is to tip over. Frequently the flange tires keep the front wheels close to the rail, and thereby avoid an accident.

Mr. J. F. Deems (Chicago, Burlington & Quincy)—Two years ago or more, on the part of the road on which I am located, we experimented with flange tires on all the wheels of mogul engines, for the same reason that Mr. Peck mentioned, to reduce the flange wear on the front tire, and it has proved very successful. We have succeeded in running the engine twice as long before it was necessary to turn the tires on account of the flange.

Mr. D. Hawkesworth (Burlington & Missouri River)—We have four consolidation engines, with about 175,000 lbs. on the driver. With flanges on the drivers we experienced a great deal of difficulty in running the engine. We have 16-degree curves and 3 per cent. grades. Our track on the Black Hills line is equipped with pine ties, and we had a great deal of trouble with the ties, and we had a great deal of trouble with the spikes holding the rails, the spikes pulling right out of the pine ties. We finally had to take out the second pair of wheels and put on blind tires. We made those tires 2 in. wider than usual, and that prevented the engine from getting off the track.

Mr. G. W. Rhodes (Burlington & Missouri River)—The point that Mr. Hawkesworth brings up is an interesting one, because on the particular portion of line on which he used flange tires on four-wheel connected engines, it was possible to make some estimate and some measure of the damage done to the track. The ties were the soft pine ties, and no tie plates were used, and in going over the line at that time, the Road Master talked to me about the engines, and said that he absolutely could not keep his track safe with those engines, and we did at one period lay up the engines. The reason for that was that he had spiked his ties so much in trying to keep the gage, that, as he expressed it, he had spiked his ties to death. New ties were hard to get at that time, and he could not get tie plates, and, therefore, for the time being with these all-flanged engines he could not keep his track in gage.

Mr. T. R. Brown (Pennsylvania R. R.)—I am one of the members who has no use for blind tires. If we have one, the first time the tire is turned, we put on a flange. I have no doubt the members have seen the diagrams I have brought to these meetings on different occasions. The practice recommended by the Committee for consolidation engines is what we have been using right along, with the exception that we keep the backs of the tires all the same. If the curve has the proper elevation there is no trouble with flange tires.

Mr. W. McIntosh (Central of New Jersey)—We now have in service 25 very heavy consolidation engines. They weigh 205,000 lbs. They have now been operated a year with all-flange tires, fitted up substantially, as the Committee recommends, and they are giving excellent service. They neither wear the flanges unduly nor do they wear the opposite wheels, or deface the driving box to any unusual extent.

Mr. G. W. West (New York, Ontario & Western)—The road with which I am connected had the two middle drivers on the consolidation and the middle pair on the mogul engines all bald in 1891, and it was almost impossible for us to get 20,000 miles out of the forward tires of the moguls without turning them. We gradually began putting flanges on all drivers, and at the present time on our engines, mogul and consolidation, we have flanged tires, and we have entirely overcome the trouble from worn flanges. About two years ago we had a train of 35 cars get away and run down a grade 70 feet to the mile. The car next to the engine left the track at a high rate of speed and went down an embankment. Before the car separated from the engine, the engineer went back to set some brakes, and help stop the train, and he and the conductor and one trainman were killed. After the engine reached the bottom of the grade, we found every pedestal brace was knocked off the pedestals, showing the immense speed at which the engine was going down the grade. The grade was full of curves. We considered that this showed that the flange tire was perfectly safe.

Mr. Robert Quayle (Chicago & Northwestern)—After hearing the Committee's report last year, I went home, determined to make a test of flanges on all driving wheels. We placed some tires on engines doing work in a switching yard, where we were having the most trouble, the engines being fitted up according to the recommendations of the Committee: it has reduced our flange wear.

Mr. F. A. Delano—There is little doubt that the Committee is right that it is able to reduce flange wear by flanging the middle wheels of mogul and consolidation engines. But it seems to me that it is done at the expense of the track. For nine years I was in a position where I was more responsible for the track than I was for the locomotive, and I had an opportunity to study that side of the question. I have found on sharp curves long shavings of steel taken off the rail by the flanges of the wheels. Then there is another consideration. When there is a frog on the curve, there are two guards, a guard rail opposite to it as well as the guard rail at the point of the frog. If any one will lay out on a drawing board the conditions which exist where there is a frog on a curve, with a guard rail opposite to it, and then locate his flanged tires on the long wheel base locomotive, I think he will soon satisfy himself that there is a limit of curvature around which that locomotive cannot pass without spreading the track. For the consolidation engines that we are using on the C., B. & Q., I found the limit of curvature to be about 9½ degrees. I do not know whether the Committee touched on one point, but it seems to me it would accomplish what the Committee seeks to accomplish, diminish flange wear, and perhaps do as much good as any other method without injuring the track, and that is to have the pilot truck, whether a single or double truck, do more to guide the engine. With blind tires and a floating truck, the front flange has to do all the guiding. If there is more study of the form of the swinging motion in the leading truck, it would do a good deal towards assisting the front drivers in guiding the engine. In answer to one of the questions put in regard to 10-wheel engines with fixed trucks, I think that is not an uncommon thing. One division of the road with which I am connected has ten 10-wheel engines, the double truck of which is equipped with a center pin. The front driver is blind and the two back drivers are flanged. These engines operate on fast trains over sharp curves, and they take the curves very smoothly, as smoothly and as easily as any American type engine.

Mr. S. M. Vauclain (Baldwin Locomotive Works)—It seems to me that the conclusions of the Committee are all right. We have been building hundreds of locomotives in the last three or four years, having a wheel base as much as 16 ft. 4 in., with flanged tires on all wheels; and for all ordinary railroad practice, if the engineer takes the fact into consideration that these engines have flanged tires, I think that the guard rails, frogs, switches, etc., can be safely arranged for engines of that kind.

COMPOUND LOCOMOTIVES.

Mr. W. S. Morris (Chesapeake & Ohio)—In going over conclusions arrived at from replies to the circular of the Committee, there are some points I would like to take exception to as not entirely coinciding with our experience. We would recommend as large drivers on the compound as possible, to reduce piston speed. The rating should not be higher for the compound than for the simple engine of the same tractive power, and its conversion into simple should not be resorted to, except in starting or to prevent stalling in case the proper load is exceeded. For some unexplainable reason, a great deal of stress has been laid upon "manual control of the compound feature." It is not clear what this really means, but we would call it the emergency feature, and it should be under control; in other words, operative at the will of the engineer. It is not good practice to introduce an additional lever for the engineer to operate at every start, as in eight years' experience with the compound locomotive we have not found a single occasion for its use other than just indicated—for emergency. The principle of manual control cannot be fully applied under any circumstances, as the starting device must have an automatic reducing valve, and this is the most important valve in the whole device, and the chances for a possible sticking is no greater in one case than in the other. In fact, we have yet to hear of the first occurrence of any disarrangement of either after the cylinder has been properly cleaned of moulding sand in the steam passages. Reference is made to the by-pass valves, which we consider as an absolute necessity for a successful compound, and the larger the better. We are using valves of 4 in. in diameter for 32 and 33-in. cylinders, and by careful investigation it is found that a reduction of 40 to 50 per cent. in the vacuum in the smoke-box is obtained by their use. It is not necessary to have any supply of fresh air through the steam chest relief valve in connection with the by-pass valves, as, by its removal, a further reduction of the vacuum would be obtained, which we, however, have not found necessary to do. There is no question but that suction or vacuum in the cylinder can be removed by slightly opening the throttle, as some advocate; but this has the same effect of fanning the fire as has a sufficient supply of external air, and which is the very evil that we want to remove. So far as we know, there is no other method suggested that will accomplish this as well as the by-pass valves. We have found the lubrication less on the compound; but think it advisable not to attempt to save on this item. In connection with the remarks on improvements, we will mention that the intercepting valve we are using is of the same design as that used eight years ago, and we have not as yet found room or reason for improvement. The one referred to is working to-day as well as when it was first applied, and has not cost a cent for repairs. In the slide valve and steam distribution considerable improvement has been made. In this connection, I refer to the application of the Allen valve, having the auxiliary port so arranged in relation to the steam ports in the valve face of the cylinder, that it serves as an exhaust port in the early part of the exhaust period, thus relieving the back pressure in the cylinder to a considerable extent, especially at high speed. By special investigation we have found with an engine on which the double ported valve was put in the place of the old plain valve a speed of 26 to 39 miles per hour, indicated a gain of 18 to 41 per cent. in power comparatively, and would undoubtedly have continued at that rate still higher if we had had cards from the plain valve for comparison at higher speed. There are two peculiarities in the compound not brought into general notice, which are of inestimable value to the railroad, perhaps as much so as all the other advantages combined. One of these is that of starting a heavy train as compared with the simple engine. The simple engine can seldom start its train without taking slack, and often repeats this process three or four times. The consequent shocks to draft rigging and cars are well known, and are probably the hardest part of the service, few riggings being strong enough not to be subjected to a strain far in excess of their elastic limit. The starting of the compounds differs considerably in this respect from the simple engine, especially since enginemen have become familiar with the handling of the machine. There is no need of taking slack, and consequently the slack that generally exists in the train before starting is taken up with care and gentleness, and brings the engine to an apparent standstill about the time when all couplers are stretched. From this moment the actual starting takes place, and, as there is no lost motion left, there can be no appreciable jerks in the train. This valuable advantage cannot be overestimated, as it necessarily reduces the repair expenses and prolongs the life of the rolling stock in general. The other peculiarity is the possibility of utilizing from 33 to 35 per cent. of the weight on the drivers for tractive power in emergency. This feature, however, is not so easily explained, but makes it possible to handle the trains under all conditions without resorting to the destructive utilization of the slack.

Mr. S. M. Vauclain (Baldwin Locomotive Works)—There are some of the conclusions which I do not entirely agree with, but my disagreement with these conclusions is perhaps of minor importance when the full purport of the report is taken into consideration. When we consider the state of the art in this country, I think that no one can take exception to changing the first conclusion to read something as follows: "Compound locomotives have not been generally adopted by railroads in America, but are rapidly coming into use for both freight and passenger service." In defense of this alteration, I wish to recite the condition of affairs that exists in our Works to-day. We will, by the first of January next, finish 1,200 locomotives this year. Of this number from 300 to 400 will be foreign locomotives, and 800 will be domestic locomotives. Of the latter number some 500 of these locomotives will be compound. Over 50 per cent. of all the modern American locomotives built to-day are being constructed on the compound principle. I

therefore feel that it is due the builders, not myself or the Baldwin Locomotive Works, but all builders of locomotives in the United States, that we do not say that we are still in the experimental stage with compound locomotives. If we say that, what would we think of a railroad manager who places an order for 165 compound locomotives at one time? Another manager who places an order for 65; another for 60; another for 22; another for 15; another for 10. If we are in the experimental stage with compound locomotive work, this is all wrong. As to the first line of the conclusion, that "compounds have been in use in freight service longer than passenger service," I beg to say that the first compound locomotive that was built in this country by the Baldwin Locomotive Works, and about the first put in service in this country outside of experimental types was a compound passenger locomotive for the Baltimore & Ohio R. R. I have been advocating the use of compound locomotives ever since, and it is not necessary for me to say what four-cylinder compounds are doing for passenger service in the United States and other countries. The reason that more compound locomotives are used in freight service is simply because there is more freight to haul than passengers.

The "flexible" paragraph was perfectly well understood by me. I differ from it, however. I think compound locomotives are just as flexible as simple engines. For interchanging of locomotives in pooling, compounds are as flexible as the simple engine. But to take a division of a road with fifty simple engines and one compound and pool them, the chances are the compound would not be so flexible. It will be a total wreck after a time. The reason is that every engineer on the division has to be educated in the mysteries of this particular compound engine.

Mr. F. A. Delano (Chicago, Burlington & Quincy)—I notice the statement that "there should be no difference in the size of drivers between the compound and simple engine in the same service." I thought, from information I had gathered, that there were some good arguments in favor of larger drivers, proportioned to the stroke in the compound as compared with simple engines. I believe slow piston travel is an important thing with all engines, but is there not more argument in favor of slow piston travel with compound than with the simple engine? The road I am with has not many compounds, but we have had extraordinarily satisfactory results with two two-cylinder compounds in freight service on low grade lines. We have also had four-cylinder compounds in passenger service where they have shown exceptionally good results, and we are so satisfied with them we are going to order more.

It is said, "There is no necessity for any difference in the size of the exhaust nozzle of the compound and that of the simple." I should question that a little for the two-cylinder compound. It seems to me in that particular the four-cylinder compound of the Vauclain type or tandem type will have an advantage over the two-cylinder compound in high speed work, that there is double the opportunity of getting rid of the steam from the low pressure cylinder. I should rather question that conclusion with a two-cylinder compound, that the exhaust nozzle should be the same as for a simple engine. The pressure of the steam is less, and I think you would naturally suppose that the aperture through which it must escape must be larger in order to give it an opportunity to release itself at the same speed.

Mr. J. F. Deems—In regard to what Mr. Delano and Mr. Vauclain have said relative to the first conclusion, I would say that there was a good deal of discussion relative to that conclusion in the Committee, and we realize that the language might be misinterpreted. The Committee would have no objection to altering the language of it, but I think if any one will take the trouble to read all the replies they would say without hesitation that the conclusions are based strictly on the replies which are received. The information Mr. Vauclain has given is information the Committee did not have before, and could not be influenced by it. It is something which has come up since the report was prepared, and might have influenced the report very materially.

Prof. W. F. M. Goss (Purdue University)—I think there is a sense in which we may say that all modern locomotives, including locomotives of the best type, are experimental. We are in the process of moving on from weights of 100,000 lbs. to 250,000 lbs., and that process necessarily involves a considerable amount of experimentation. It is quite likely that the problems which such a process presents in connection with a simple engine are as difficult and involve as much uncertainty as the problems presented in connection with the compound feature of the engine. The progress in compounding in America has outstripped the progress of any country I know of. I believe the conception of the advantages of the compound may, perhaps, have reached a higher altitude in Russia, and I am inclined to think it has also reached a higher altitude in France; but in the practice of building and designing locomotives, we certainly lead them all. I want to call the attention of the Committee to the fact that it has omitted two classes of engines which, perhaps, are worthy of classification with those given in the report. I refer to the four-cylinder, four-crank compound of Mallet, and if there were more time I would be glad to speak of the four-cylinder compound of the Northern Railway of France.

Mr. George Gibbs—In these conclusions of the Committee there is one important point it omitted to touch upon which makes the use of the compound almost imperative in railroad service. As is well known, the railroads of this country are engaged at the present time in completely changing their motive power. They are building the heaviest possible engines both for freight and passenger service. The evolution means that we are going to the maximum possible weights on the drivers, and maximum possible boiler capacity, and that is limited by the weight on the drivers. It has been well demonstrated that the compound can save anywhere from 15 to 20 per cent. in fuel and a corresponding amount of water. This simply means where you have got to limit the steam heating capacity, you are going to get that much more out of a given weight in a compound locomotive than in a simple locomotive you have that much more powerful locomotive to pull the train, because the limit in pulling capacity is simply the capacity of the boiler and not the weight on the drivers for fast work. I think that point should be taken into consideration in connection with the compound.

Mr. R. Atkinson (Canadian Pacific)—It may be of interest to learn that at the end of this season we shall have about 178 compounds on our road.

Mr. T. W. Gentry (Richmond Locomotive & Machine Works)—As to the point that the compound is not so flexible an engine as the simple, I believe it has been decided by every one who has had any experience with compound engines in passenger or freight service, that flexibility means the ease with which an engine may be swapped from one service to another. Nearly all our mechanical men would understand the compound engine could be placed in the same service as a simple engine. I am satisfied the experience of any one who used them would bear that out.

There is one other recommendation, as to the manual control of the compounding feature being preferable to the automatic. I would imagine that that meant they would necessarily have to put a lever in the cab, and perhaps some quadrant or rack or means to hold it in position. The compound engines built in the last few years by us have been of the heaviest type, and we have been driven to all sorts of schemes to arrange the cab so that the engineer can get around the boiler head. The more we can leave off the boiler-head the better, and the smaller and lighter they can be made the better.

Mr. J. E. Sague (Schenectady Locomotive Works)—In connection with the conclusion in reference to manual control of the compounding feature as being preferable to the automatic, I think the exact wording of the conclusion is a little unfortunate. As I understand it, the wording of the inquiry was such as to lead people to answer in accordance with their preferences. I think the preference of the majority of the people who use two-cylinder compounds is in favor of those that can be operated either simple or compound, and if it is agreeable to the members of the Association, the Committee might be allowed to change the wording to cover that point. In regard to the attitude of some of the builders of compound locomotives, I would say that I can speak for the Schenectady Locomotive Works to some extent, and say that we favor the compound engine very thoroughly. We have had very flattering reports from most of the compounds we have built during the last six or seven years, and we consider the compound engine entirely out of the experimental stage, although improvements in details may be made from time to time. For heavy freight service, at least, the compound engine is surely sufficiently better than the simple at this date.

There seems to have been a tendency to decry two-cylinder compounds for passenger service. I believe that the two-cylinder compound is thoroughly well adapted to passenger service, and, in some cases, will effect as much saving in passenger service as in freight service. This is not generally the case, however, as a simple passenger locomotive operates at a better rate of expansion than a freight locomotive, and, therefore, there is not the same chance to gain so much for compounds in passenger service as there is in freight service. That applies to all compound locomotives. In one case, trials were made of two locomotives, one simple and one compound, for passenger service. The indications were that the compound was better for certain heavy divisions where the runs were long and continuous, and the simple was, if anything, better on some undulating divisions. The result was that we got an order for engines, part simple and part compound. Before the order was executed, we were asked by the officials of the road if they could not change the entire order to compound locomotives.

The weight of the reciprocating parts has not been touched on in this discussion. It is an impossibility to make reciprocating parts as light in a compound locomotive as in a simple locomotive. We have urged for years in this Convention that reciprocating parts should be reduced to the minimum, and builders have made great effort to this end. But this has been lost sight of somewhat in compound locomotives in passenger service. We think it would be well to state in locomotive specifications that the dynamic effect upon the track must not exceed a certain amount, say 25,000 lbs., for each driver, at 60 miles an hour. I have only known of two cases in my experience in which the railroad has analyzed the effect of the reciprocating parts on the track.

One other point occurs to me, which is the use of compound locomotives among a number of simple locomotives. It has been stated that under these conditions the compound occupies an unfortunate position. My experience has been rather different from that. We recently built a compound locomotive for service among a lot of 18 simple locomotives. The pooling system was used and the results of the compound locomotive were so favorable that the men tried to get the compound in preference to the simple engine.

A motion to omit the first conclusion from the report was carried unanimously. This is the one about the compound coming out of the experimental state.

TOPICAL DISCUSSIONS.

Has the limit of length of tubes, 2 in. in diameter, been reached in locomotive practice?

Mr. S. M. Vauclain (Baldwin Locomotive Works)—It is my opinion that we have not yet reached the limit of the use of tubes 2 in. in diameter. In the defense of this position, I wish to give an idea of how 2-in. tubes have grown in the recent past. On consolidation locomotives it is necessary, in order to design a perfectly satisfactory locomotive, to use long tubes; and for the Baltimore & Ohio 2-in. flues 14 ft. 10½ in. long have been used, and for the Lehigh Valley 2-in. tubes 15 ft. 1 in. have been used. In ten-wheel engines this growth has been more decided. In the years back, 2-in. tubes were 13 ft. long. Then they went to 14 ft., and engines for the Wabash Railroad have tubes 14 ft. 3 in.; Atlantic Coast Line, 14 ft. 5 in.; Chicago & Great Western, 15 ft.; Fitchburg, 15 ft. 1 in.; Chesapeake & Ohio, 15 ft.; Chicago, Milwaukee & St. Paul, 15 ft.; Chicago, Rock Island & Pacific, 15 ft.; but this type of engine, the ten-wheeler, does not admit of the longest tubes that can be used. For instance, for the Atlantic type engine, we have used tubes for the Lehigh Valley 15 ft. 1 in., and on the engines for the Black Diamond Express, 15 ft. 6 in.; St. Paul & Duluth, 15 ft.; Central Railroad of New Jersey, 15 ft.; Chicago, Milwaukee & St. Paul, 15 ft.; Erie Railroad, 15 ft.; and last, but not least, the Chicago, Burlington & Quincy, 2-in. tubes, 16 ft. long. Sixteen-foot tubes, 2 in. in diameter, are reasonable things to use, and why is it? Because our friends on the opposite side of the water have long used 2-in. tubes 15 ft. and 16 ft. long. On the Griazi-Tsaritzin Railway you find 2-in. tubes 17 ft. 5 in. in length and on the Balaklava Railway, on small locomotives, tubes 15 ft. 5 in.; and in some of the Russian locomotives they have 2-in. tubes 18 ft. 1 in. in length. I have no hesitation whatever in making the prophecy that we will find 2-in. tubes in locomotive boilers in the near future 20 ft. long. I do not wish to appear unreasonable but there is a certain use that the additional length of these tubes can be put to, if a locomotive is properly designed, that will be of decided benefit and advantage to the locomotive. In regard to the rigidity of the tube and the absence of vibration when it is in the boiler, I think we need not give that any consideration at this time. Tubes are fitted in locomotive boilers 15 ft. long, and 15 ft. 6 in. long. In certain locomotives built recently the tubes are 16 ft. 7¾ in. long. We ship these locomotives without any water in them. If that does not afford a splendid opportunity for the tubes to vibrate I want to know it. If a brass tube 2 in. in diameter, 15 ft. long, or even 16 ft. long, will give no trouble, I can see no objection to the use of an iron tube 20 ft. in length.

Mr. S. Higgins (Lehigh Valley)—In 1896 the Baldwin Locomotive Works built five engines of the Atlantic type for our road, with tubes 16 ft. in length. We were forced into this on account of the design of the running gear, and we were doubtful whether or not they would do. They have been in service since that time on a division where we run the engines 400 miles every 24 hours. We have had better results with these long tubes 15 ft. 1 in., than with flues 14 ft. and 14 ft. 6 in.

Mr. W. McIntosh (Central of New Jersey)—I wish to corroborate what Mr. Higgins said in regard to the service of tubes 15 ft. in length. We have a number of engines thus equipped, and we do not find less satisfactory service from them than from shorter flues.

Mr. F. A. Delano (Chicago, Burlington & Quincy)—The C. B. & Q. has been making some experiments for some time to determine how much it could diminish the diameter of the tubes or lengthen them. A number of years ago it was found that 2-in. tubes 12 ft. 6 in. in mogul locomotives did much better than tubes 2¼ in. in diameter. There was less trouble from leakage and stopping up. Within the last year the thought occurred to us that we might carry the experiment even further and we tried a locomotive of the same class with tubes 1¾ in. in diameter and 12 ft. 6 in. long. The experiment resulted so satisfactorily and the engine appeared to be so much better than other engines of the same class, that in getting up designs for new engines, we carried out the same ratio, or very nearly the same ratio of diameter of tubes to length, which we did in the 1¾ diameter tubes. In some engines with 16-ft. shells, we are going to use 2-in. tubes. We have not had any of the 16 ft. tubes of 2-in. diameter in service long enough to know how they are going to turn out; but we have had 16-ft. tubes, 2¼ in. in diameter, and have not had any trouble from their pulling through the sheets; no trouble of that kind at all. I can not see that decreasing the diameter would increase that trouble. With smaller tubes I think we can safely use a thinner gage of metal in the tube and therefore get our gases nearer to the water.

Mr. Robert Quayle (Chicago & Northwestern)—We have many locomotives on our line that have tubes 15 ft. 2 in. in length and they have never given us any trouble in particular, except when they were first shipped from the locomotive works to us without water in the boiler, and then we found they gave us trouble from leaking. We asked the builders to ship the next lot with the flues covered with water, and that stopped the trouble. These engines have been in service for some years and give us no more trouble from stopping up or leakage than any other engine; and that was the reason we arrived at the conclusion to build these locomotives we are getting now with 16-ft. tubes. I think other railroads have de-

termined they will go us one better than that shortly. We are having less trouble to-day, it may be because of better care of our boilers and tubes, from leaky flues than ever before. I think, therefore, we have not reached the limit of the length of the tube.

Mr. Geo. L. Fowler (Consulting Engineer)—I think, before the length of the tubes is increased to 20 ft. it would be well to make careful experiments to determine if the front ends of such tubes are of any value for steam generating purposes. If you reduce the temperature of the gases down to the smoke-box temperature 3 ft. before they reach the end of the tube, the 3 ft. are of no value for generating steam. I do not think any experiments have been made on this point in this country and only in one instance abroad.

Mr. F. A. Delano—I want to say in the engine with 1¾-in. flues we found that the increased heating surface of 10 per cent. enabled us to increase the size of the nozzle tip about ¼ in., so we estimated we could gain largely from that source, the gases passing through the tubes at a slower rate of speed.

METAL VERSUS WOODEN CABS FOR LOCOMOTIVES.

Mr. J. E. Sague (Schenectady Locomotive Works)—The relative advantages of wood or metal cabs have been considered by all mechanical officers and locomotive designers, and it probably looks to many that the future development of American locomotives will involve a much more extensive use of steel cabs conforming to the almost universal practice in foreign countries. Considerable can be said on both sides of the question.

In favor of metal cabs: Increased strength and durability, and thus lower cost of maintenance. Steel cabs are standard on all Southern Pacific lines, and their mechanical engineer, Mr. F. W. Mahl, advises me as follows: The first steel cab built was in 1891 on the Southern Pacific system in Arizona. In July, 1895, nothing had been expended for repairs. Since 1895 no wood cabs have been built.

In 1895 a number of 22 x 26-in. mountain locomotives were built with steel cabs. Nothing has been expended on them for repairs.

It is reported that paint on metal cabs lasts longer than on wood. The Southern Pacific cabs are lined and have double roofs, and are said by engineers and firemen to be as cool as wooden ones.

Against steel cabs: Are increased first cost and increased weight. At present prices of material average steel cabs cost $100 more than wood. Their increase in first cost is probably justified, however, in view of the saving in maintenance. The increased weight is a more serious feature. Comparison of the weight of average designs roughly shows for small cabs 900 lbs. increase, and large ones 1,300 lbs. Some special designs show 1,500 lbs. or higher. This increase prohibits the use of steel cabs in some new designs where all possible must be done to save weight at the back end of the engine to keep within driving wheel weight limits and obtain maximum boiler power. This would apply to many recent designs of large passenger engines, examples of which will readily occur to all. In other types the extra weight of steel cabs may improve the distribution. Many cases will occur in which increased weight is allowable in renewals where railroad men have latitude in new work as the bridges and track get stronger and the bridge and track department grow less conservative. Steel cabs are almost essential also in hot and dry climates, or where moisture and dryness are destructive to wood.

Mr. Robert Quayle (Chicago & Northwestern)—I believe it will pay railroads to get new cabs rather than to add very much to their weight. The steel cab is a very good cab. I understand that anywhere from 80 to 90 per cent. of the cabs being built to-day are made of steel. I presume it is because the builders have found in practice that it is durable. It costs a little more, but it must have some advantages in maintenance or the men who are building the engines would not recommend them. On our line we are now considering the use and probable adoption of the metal cab.

The Executive Committee recommended that Mr. Frederick B. Miles be elected an honorary member of the Association, which was done.

The report of the Committee on Changes in the Constitution was presented and, on motion, the Secretary was directed to submit the proposed changes to the membership in the proper way for vote.

THIRD SESSION—JOURNAL BEARINGS, CYLINDER METALS AND LUBRICATION.

President McConnell—We have with us this morning Mr. G. H. Clamer, the chemist of the Ajax Co., and we would like to hear from him as regards the amalgamation of certain metals and the effect of lead in copper and tin.

Mr. G. H. Clamer (Ajax Metal Co.)—In looking over this report, I notice that almost every road has a different composition for journal bearings, and I venture to say that in the case of the majority of railroads in this country they do not know what the composition of their bearing metal really is. I have paid a good deal of attention to this subject during the past years, and carried out some experiments, principally with the introduction of lead in these bearings. I think it would be well if we would have before us first the requirements which should be met by a good bearing alloy. The general requirements can be summed up under four heads: First, that the metal should show the least liability of heating under all circumstances. Second, that it should have sufficient strength and a sufficiently high melting point not to be squeezed out under the effects of load and friction. Third, that it should show the least possible abrasion in service. Fourth, that it should show the least possible abrasion of the journal.

There are but four common metals which can constitute the basis of a journal bearing. They are copper, tin, lead and zinc. These metals may be alloyed in various proportions with each other or with other metals, so that numerous formula may be compounded. But they may be summed up under three general heads: First, the white metals, or, as they are sometimes called, soft metals, which include the metals having as their basis either tin, lead or zinc. The second class are the ordinary bronzes, or the copper and tin; or copper, tin and zinc. Third, are the plastic bronzes, which are copper and tin alloys containing lead of which phosphor bronze is a type, and this metal I find to be the one chiefly used to-day.

The white metals meet most satisfactorily the first requirement, that is, that they possess anti-frictional qualities more than the other two classes. I do not mean to say that the co-efficient of friction is less, but on account of their plasticity they adapt themselves to any irregularities of the journal or dust particles, and thus distribute the load equally over the journal. They do not meet the second requirement of having strength, however, and a sufficiently high melting point. As regards the third, they show less abrasion in service than any of the other metals. It seems to be the common opinion of a good many that a hard metal is required to resist wear, but this, I find, to be an entirely mistaken idea, as lead, which is the most plastic of all metals, if it is run under a pressure insufficient to cause a permanent distortion, will resist wear more than any of the combinations of metals. I have seen instances of lead lining only 1-16 in. thick which has been in service over nine months, and was not yet worn off.

The ordinary bronzes do not meet the first requirement. They are hard and unyielding by their nature, and any irregularities of the journal will cause the load to localize on one or more points, thus creating friction and cutting. They, of course, have sufficient strength, but as far as wear is concerned, the wear is considerably more than is the case with the white metals.

The plastic bronzes, which contain lead, are between the two as regards wear, and the wear decreases with the increase of lead in this alloy. The valuable experiments which were made by Dr. Dudley years ago, are probably well known to many of us. The conclusions which he drew are results of experiments which he made with the copper, tin and lead compositions, and he concluded that wear decreased with the increase of lead, and it also decreased with the increase of tin, showing that as the plasticity of the metal is increased the wear is decreased. They approach the white metals in this respect. The copper, tin and lead alloy by microscopic examination shows a structure similar to the honeycomb, in which the copper and tin forms the cell walls, and the lead may be represented by the honey which is enclosed within these cells. Thus an alloy of this nature is given the strength of the copper and tin and the plasticity and anti-frictional qualities of the lead.

I notice in this report that mention is made of the lubricating quality of lead. Now this is so to a certain extent, although the babbitt metals such as have lead for their basis, show a greater co-efficient of friction than the copper, tin and lead alloys. Still the lead, on account of its lubricating qualities, seems to decrease the friction in such an alloy as this.

I would like to say one word in regard to the use of scrap which contains a considerable portion of zinc. I have found by my experiments that such metals will show anywhere from one to five or ten times the wear which is shown by phosphor bronze. Such a metal as this, although it will run cool in service, is objectionable on account of rapid wear. If there is any little irregularity in the journal, the bearing may adapt itself by wearing away, whereas, the bronze which contains lead, and particularly the bronze which contains a higher percentage of lead, will adapt itself to these little irregularities without wear. And, as I said before, the good qualities of the copper, tin and lead alloy increase with the increase of lead, and decrease with the tin in the composition.

Mr. F. A. Delano—I want to point out one thing. A great many roads think they are using a hard metal bearing. But in all cases, however hard their bearing, they use a lead lining. That lead lining began by being a thin detached sheet of lead. Afterwards it was lead that was poured in, and began by being 1-16 in. thick, and has gradually grown from that. My observation is that on roads using a hard metal bearing a majority of the running is done on the lining, and that the brass is taken out soon after the lead lining is worn out, the brass rebored and relined again. I mention that because I think it is very easy to deceive one's self in that way. And as I do not believe that lead lining is a good bearing metal, on account of its being too soft, and forming a lap with grit and sand, I believe it is a good argument for the use of a filled brass with some other bearing metal.

Mr. F. M. Whyte (New York Central & Hudson River)—The Committee seems to be on the fence in regard to providing a hard metal in the cylinder; that is, a hard-wearing surface inside the cylinder and at the same time provide a soft metal in the saddle. It seems to prefer the saddle cast with the cylinder, but thinks the cylinders should be harder than the saddle, or the wearing surface of the cylinder harder than the other parts of the cylinder casting. Now, it is not necessary to go to the separate saddle in order to get the advantage of the hard metal in the cylinder. The cylinder may be bushed, and it is the practice for some roads now to bush cylinders even when the engines are first built. To get the full advantage of this, the valve seat should also be what is called a false seat, and that can be made of hard metal, too, and with this combination I think the Committee might have recommended that the saddle be cast with the cylinder, the cylinder bushed and the false valve seat used.

PISTON VALVES.

Mr. F. A. Delano—My predecessor adopted piston valves on some simple engines, and they did so well that they might be said to be standard on the Burlington Road for new work. We have about 65 simple engines with piston valves. They all take steam on the inside, and the performance of the engines has been very carefully watched. We were unable to furnish the Committee with any definite data about the matter. In fact, we feel that the thing is somewhat in an experimental state. At the same time we feel absolutely confident that if the valve is not just exactly right we can make it right. One of the conclusions we have come to that may be of interest to the Committee is that with a piston valve, with internal admission, if the valve is closed, there is a negative pressure on a portion of the movement; that is, in valve frictional tests we find that the valve runs away from the steam. We think that this is more or less objectionable in tending to pull and push all the lost motion that there may be in the valve motion, and we rather came to the conclusion that a valve with a hole through it is a better thing. There is an objection, however, in a valve with a hole through it that the live steam is jacketed by exhaust steam and cooled to a certain extent. So that we have a choice between those two evils.

President McConnell—We would like to hear from Prof. Goss on this subject.

Prof. W. F. M. Goss (Purdue University)—The Committee suggested that by the use of piston valves the internal resistance of the locomotive may be considerably reduced. I think the energy absorbed by valves, even though they may work very hard, is never any very considerable portion of the entire energy developed by the machine; so that even though we reduce valve friction, we do not materially reduce the internal resistance of the machine. The trouble introduced by valve friction is that the distribution is distorted, and we strive to reduce valve friction by the adoption of piston valves that they may always insure such distribution as we desire. That, I think, states the problem perhaps better than the statement referred to in the report.

Mr. G. R. Henderson (Chicago & Northwestern)—I agree in the point made by Mr. Delano, that it is easier to handle the engine with the piston valves, and we found that we could move the reverse lever with one hand, the train running at 50 miles an hour, without having to brace yourself. One point I would like to refer to which is on the second page, speaks about the valve gear having to be specially designed to suit the internal admission. The only thing to look after is this. With the ordinary slide valve, where we have the admission at the outer edge of the valve and the rocker to reverse the motion, the angularity of the eccentric rods neutralizes in a measure the angularity of the connecting rod. If you use a central admission valve and still use the same rocker design, you need a considerable offset to the link bridge pin. This occasions a large amount of slipping in the link. If, however, you use a rocker motion in connection with a central admission you get the same distribution as with the old arrangement. The new engine of the C. & N. W. which some of the gentlemen have seen on the tracks at the D. & H. Station has ¼ in. variation in the cut-off in the corner. This gradually decreases up to half stroke, and from half stroke to quarter cut-off there is no difference in the cut-off front or back.

One point I would like to call attention to in connection with the piston valve which, I think, has probably not received its full share of consideration, and that is the specific design of the packing ring. Now, we know that solid valves have been used in some places. I do not know with what success, but I believe the plain snap ring, the same as is ordinarily used in pistons, is about as satisfactory a device as can be obtained. We need a piston to fit solidly and tightly, and if we have a piston which fits tightly at one part of the valve and somewhat loosely at the other, there is a disadvantage in that. The spring rings will adjust themselves to small irregularities in the diameter of the bushing, and the spring valve has much in its favor. The spring valve will adjust itself to all these irregularities. If a valve is fitted up solid, and it is tight at one point, it will be loose at the other, and will either blow or jam, and I think that is a point worthy of consideration in the design of piston valves.

POWER TRANSMISSION BY SHAFTING VERSUS ELECTRICITY.

Mr. G. R. Henderson—There is one point which I may not fully understand. It says "a new item of expense in the care of electric machinery will be introduced which will about offset the other items, leaving the whole attendance bill practically unaffected by the introduction of electric shop power in plants of any considerable size." In an electric transmission plant which we are installing this plant is to take the place of seven isolated steam plants, and even considering the necessary care of motors, etc., it has appeared to us that we shall be able to make a reduction in attendance. I think we have all been under the impression that by introducing

a central electric power station for distribution of power, the interest on the first cost would be returned in the saving in attendance.

Mr. George Gibbs—There is always danger in generalizing, and particularly as the Committee did in that paragraph, because local conditions will affect the conclusions somewhat. In order not to go into too much detail we had to select average conditions. It is easy to imagine a case where a number of separate engine plants are in use in which a single plant might be substituted, in which the attendance item will be reduced. In all plans I have examined, there is an apparent saving which generally is not borne out in practice; that is, you gradually accumulate troubles in your line and electrical troubles of various kinds which require to be taken care of. Unless you cut down the number of boilers very much I doubt if the repair item is very much affected by electrical transmission.

Prof. W. F. M. Goss—I think the charm of this report is the candor with which the subject is treated. It really is a most inspiring document from my point of view. The electrical engineer has so many avenues among which to choose that when he attempts to write a paper of this sort it often happens that he becomes a promoter of some one particular system, and the reader of the paper fails to get a view of the larger problems involved. The Committee has avoided that difficulty entirely, and has given us a breadth of view and an unprejudiced judgment which is altogether helpful.

Mr. J. F. Deems (Chicago, Burlington & Quincy)—Mention is made of the advantages of electrical transmission due to the head room being clear of belts and other interferences. Many of us who have not had practical experience with shops where there is an electrical installation of this kind do not appreciate fully the advantages of this one item.

Professor R. A. Smart (Purdue University)—There is one especially important point brought out, and that is the fact that the economy in the installation of electrical power is found more largely in the advantage of increased output and a saving in the cost of labor than in the economy of the power itself. Most of the writers who have handled this subject have dealt rather largely with the cost of generating the power, and have neglected to place the importance upon the increased shop output that it deserves.

Mr. H. A. Gillis (Richmond Locomotive & Machine Works)—We are going to run our shops with electric power, and have already made some progress in that direction. One of the first questions which came to my mind was the possibility of failure. I was told by one of the representatives of one of the best electrical companies in the country that we had the poorest motors that are made, and these motors have not cost us one cent for repairs; and we have 25 or 30 of them. We have had them in from six months to one year. That does not apply to such minor matters as the renewal of brushes, etc., but has reference to important repairs. I do not know what we would do if we had the other companies' motors. One point not mentioned in this paper is the question of running at 500 volts, instead of 220 volts, which we use. With electric motors you can set your machinery in the most advantageous position. If you want to do work on a heavy piece you can frequently take your machine directly to the work, and set it on top if you want to. It also has special advantages in placing machinery under low-head cranes.

Mr. George Gibbs—In the report generalizations are given as nearly as we could figure them out. It is shown that in a shop where you install the generator in connection with the engine and run your tools from a shaft as before, there is no saving of power on the average. If the shop is such that you could use individual driving, with large tools, a motor on each tool, and shut down half the tools part of the time, there would be a large saving of power. In the Westinghouse Air Brake Shops very complete tests were made, and it was shown that there was a saving of 33 1-3 per cent. in power. That was due to saving in steam condensation losses and the power economy of a number of small engines supplied with steam from a central source. They cut up the long shaft into short lengths, and put in the motors, thereby saving 33 1-3 per cent. The shop is full of small machines and lathes. The work does not vary, but the economy is due to the suppression of losses in transmission. There are also losses in the electric transmission system, due to the falling short of the efficiency of 100 per cent. in the different elements. In the report is given a statement of the efficiency of an electric plant; you get a final efficiency which we have concluded on the average would be about 65 per cent., showing that you lose about 35 per cent. of the power before you get to the counter-shafting. But if you will look at the last paragraph of the report, you will find in the Baldwin Locomotive Works that "the cost of electric power at these works has been estimated at about $1,200 per week, which sum includes cost of fuel, engineers and firemen, labor and material for repairs of power house, lines and motors. It also includes interest and depreciation on the first cost of the plant. It is interesting to note that this entire amount is about 1.2 per cent. of the shop pay-roll." If you save 10 per cent. of that you can see what a relatively small percentage it is. On the other hand, there are two erecting cranes, resulting in the saving of about 80 men; a saving of about 40 men in the wheel shop and something like the same number in the crane shop. These labor savings overshadow any possible small savings in fuel economy. These fuel economies are practically of no importance, and that is the point the Committee desires to bring out. This Committee put minor stress upon the question of fuel economy, and tried to bring out the other points more clearly which we consider to be more important to railroad men.

As to 500 volts versus 220 volts, I have no doubt it is better to use the 220 volts. In the 500-volt machine you save something in wire, because you use smaller wires. On the other hand, you get a motor which is not practicable for shop service. The voltage is dangerous; it is not enough to kill a man, but would give him a bad shock, and if he held on long enough it would kill him. With continuous current motors, the brushes are in trouble all the time. The repair men do not like to adjust the troubles on these machines until they are compelled to, as the voltage is so high. I think the 220-volt motor is the best.

BEST TYPE OF STATIONARY BOILERS FOR SHOP PURPOSES.

Prof. W. F. M. Goss—I am naturally interested in the suggestions of any Committee with reference to work which may be undertaken at Purdue University. The suggestion is made by the Committee that comparative tests be made to determine the efficiency of boilers of different types. I suppose there really is considerable data upon the subject raised by the Committee, and that, perhaps, a review of this data would settle the questions which the Committee raises. Boiler efficiency, generally speaking, is a question of heating surface, and, other things being equal, that boiler is most efficient which has the most heating surface. The question whether the boiler should be of one type or another for shop use is largely a question of adaptability of form, and not so much, it seems to me, a question of efficiency. I am not inclined, therefore, to give very great emphasis to the particular suggestion of the Committee with reference to the desirability of tests.

Mr. G. R. Henderson—There is one point in this report to which I think exception ought to be taken. Referring to the second drawing of the report, it will be noticed there is a passage between the top of the boiler and the top of the setting, and the Committee makes the suggestion, "It is evident in thus returning the gases over the shell, that any remaining calorific properties contained in these gases and products of combustion are utilized to some extent, and are made to impart their remaining heat to the exposed surface of the boiler shell, whereas, in the ordinary tubular boiler construction they are allowed to go to waste in passing directly through the smokestack." I do not believe it is possible that any superheating of steam can be obtained by such an arrangement, because to superheat steam we must rise above the temperature of saturated steam, and there must be no water present. Here it is suggested to have superheated steam in the upper part and saturated steam in the lower part. I do not believe that is a possible condition.

Prof. W. F. M. Goss—I do not think the arrangement described is a good one. It is one that we see occasionally, but there are some dangers in that arrangement which I have never been able to entirely put away from my mind. It will be seen that a boiler set in that way may be subject to considerable heating in the upper portions of the shell before steam begins to generate, and while that may never be very great, because the heat which is in the upper part of the shell must first pass through the tubes of the boiler and be reduced in temperature, yet it seems to me under the conditions of working when firing varies greatly, there must be unequal strains introduced because of that heating, which are somewhat objectionable.

The subject of superheating steam is receiving a good deal of attention in England and Germany, and I was interested in seeing at Hanover a locomotive designed for using superheated steam. I thought the arrangement an ingenious one. In place of a portion of the tubes a large flue was put through, 14 in. in diameter, perhaps, and in this flue the superheater was arranged, so that a part of the heat from the fire-box passed through the ordinary tubes, but a considerable portion went through the large tube and superheated the steam. The result was what we should expect from the work of this nature with which we are familiar. There was considerable economy in the locomotive, the results approaching those obtained by the best compound locomotives; but they discovered the same thing which we have discovered, that while superheating promotes the efficiency of the engine, it also promotes an increase in the size of the repair bills, and the former is more than offset by the latter.

TOPICAL DISCUSSIONS.

How to Make Pooling of Locomotives a Success.

Mr. G. W. Rhodes (Burlington & Missouri River)—Whatever pooling of engines there is on the road I am connected with is not of my doing. We get these things sometimes by inheritance. If I were running a livery stable, and my patrons could afford to pay what I would charge them, I would have each individual own his own horse, and have no one else but him use the horse; and I would care for it, and when he did not want it, would charge him for the keep of the horse. If they could not afford that I would not abandon the livery stable business. I would suggest that each family own its horse. If the conditions got such that that arrangement was not profitable for the families, I still would not abandon the livery stable business. I would propose something like a pool of the horses. That is about my views in regard to pooling engines. The way some of us have taken up the question of pooling is that we have jumped into the thing too quickly. When engines are not pooled the enginemen always do a good deal of repairs to an engine. If you go into a pooling arrangement, it is essential you should provide some one to do those repairs which the enginemen under the system will no longer do. Usually the fireman does a great deal to keep the engine clean. If you are going to pool the engines, the fireman does not care to do the work for some one else, and the result is with pooling engines, you find them getting into bad condition, and it is necessary to provide some one to do that cleaning which the firemen no longer do. Then, again, another very important part is the inspection of the engine. The engineer is careful to inspect and look after his engine, when he alone runs the engine; but when we take him off any particular engine and pool the engines, the chances are that this matter no longer receives the same careful attention from the engineer, and it is essential that an inspector be provided to do the work that the engineer no longer does or does not do it as thoroughly as he might.

What the engineer reports would be a little more important than what the Inspector finds, but, as a matter of fact, none of us like to report a great deal. Where engines are in a pool it is a very good plan to have the Inspector meet the engineer on his arrival, and board the engine and hear from the engineer what needs attention. If that is done, there will be a number of things the Inspector will discover and hear of which he will not get from the reports.

On one division of the road I am connected with we have, outside of our extra men, 52 crews in the regular pool. These crews operate 37 engines, showing a saving of 15 engines. If we take the engines at $10,000 each, there is a saving in investment of $150,000, an interest account of $6,000. I would take that $6,000 and hire additional men to keep up what we have lost by taking work away from the enginemen, and I would figure I could easily afford to spend that money and still save my $150,000. So, to answer the question directly, I would say be very particular to carry out your pooling arrangements as nearly similar as possible to the conditions when you had each crew on an engine. That is the best way to make pooling a success.

Mr. G. R. Henderson—In addition to the point made by Mr. Rhodes, as to reducing the capital account necessary to maintain the proper number of locomotives, there is another point which would seem to me is quite important. I have seldom heard it mentioned. Let us assume that under the method of a locomotive for each engineer, and a locomotive possibly to run one day and lie over the next, that engine will stand that service for twenty years. If a road needs 100 locomotives to conduct its business, it will be necessary to provide 100 locomotives, and we will say that these will last twenty years. If we adopt the method of pooling, or double-crewing, we get twice the mileage, and it will be necessary to supply only 50 locomotives. That saves half the capital, and gives you the interest on it for the period of ten years. At the end of ten years, the locomotives having made the same mileage as under previous conditions they would have made in twenty years, it will be necessary to buy new locomotives. At the end of ten years the designs of locomotives will most likely have changed, and instead of running from the tenth to the twentieth year with a lot of locomotives partly worn out, of antiquated design, we get new locomotives embodying the latest improvements, and get better results on the strength of the additional knowledge gained during the ten years of operation. I think that is a point fully as important as the question of reducing capital.

Mr. H. T. Bentley (Chicago & Northwestern)—On the Iowa division of the Chicago & Northwestern all our freight engines are pooled, with the exception of the time-freight runs, and we found we got better results with the time-freight engines by having regular runs. The time made by these engines on regular runs is greater than that of the average engine in the pool. On these tim-freight runs we have probably two engines, and three men and each engine will make 202 miles a day; and instead of having three engines on the time freight, we have two engines and three crews, which is much better than pooling the engines. The reason is we have two men whom we hold responsible, and who claimed the engines as their regular engines. The third man acts as a swing man, and alternately takes one engine and then the other on the run, and is held accountable for keeping the engine in condition the same as the regularly assigned man. We have in passenger service some of our locomotives that are in the pool, but we have three men on one engine. One engine I have in mind makes 404 miles every day in the month with the three crews, and we have very good results from handling it in that way.

Mr. G. W. West (New York, Ontario & Western)—The pooling of engines is bad practice. On our line all regular time engines, both passenger and freight, are advertised, and the oldest men in seniority bid for the train, and two men are assigned to each engine. We aim to put the best engines on the regular time-card trains, and the few remaining engines or crews that are required to run the extra trains are pooled. We consequently have a small number of pooled engines, and the older engineers and firemen get the best engines on the road out of this plan.

Mr. Brown—Mr. Rhodes did not wind up in the manner I expected. I thought he was going to finish up by saying he killed all his horses. I believe in double-crewing, but not in pooling. We have passenger engines running 290 miles a day. One crew runs the 290 miles, and lies off for a day, and the other crew takes the engine and does the same work. We have three passenger

trains making 240 miles a day in the same way. By double-crewing you can get all the mileage out of the engines you wish, and do away with many of the objectionable features of pooling.

GRAPHITE AS A LOCOMOTIVE LUBRICANT.

Mr. G. W. Henderson (Chicago & Northwestern)—The question, as I understand it, is in connection with the lubrication of journals, not of cylinders. We have had some little experience with graphite in its application to the lubrication of locomotive journals, but I cannot say it has been much of a success. I believe if the graphite could be introduced properly to the bearing we would get good results, but the difficulty is in getting it on the bearing in the proper manner to provide the lubrication.

ELECTION OF OFFICERS.

The following officers were elected for the ensuing year: President, Mr. W. S. Morris, Chesapeake & Ohio; First Vice-President, Mr. A. M. Waitt, New York Central & Hudson River; Second Vice-President, Mr. J. N. Barr, Baltimore & Ohio; Third Vice-President, Mr. G. W. West, New York, Ontario & Western, and Treasurer, Mr. Angus Sinclair.

Great Consolidation Locomotives for the Pittsburgh Bessemer & Lake Erie Railroad.

The world's pennant for heavy locomotive building has again changed hands. It is now held by the Pittsburgh Locomotive & Car Works. Two locomotives of the kind here illustrated were recently delivered by these builders to the Pittsburgh, Bessemer & Lake Erie Railroad. Engine No. 150, the subject of illustration, was the first of the two engines finished. They are the largest and heaviest locomotives in the world. Inspection of the illustration and the figures showing weights and dimensions gives the impression that they may hold this prestige for a long time. These locomotives will be used in ore and iron traffic, their duty being to haul great train loads at moderate but regular speeds. The net hauling capacity on straight and level track is 7,847 tons. Tractive force, at one-fourth of the adhesive weight, is 56,300 lbs. The total weight of engine, 250,300 lbs., is divided in proportion of 225,200 lbs. on the drivers and 25,100 lbs. on the truck. The weight of engine and tender, in working order, is 391,400 lbs. The frames, which are of cast steel, weighed 9,193 lbs. each when cast. The statement that nickel steel and armor plate specifications would enter into the making of these locomotives gained wide circulation in press reports. The statement was incorrect. Nickel steel was not used.

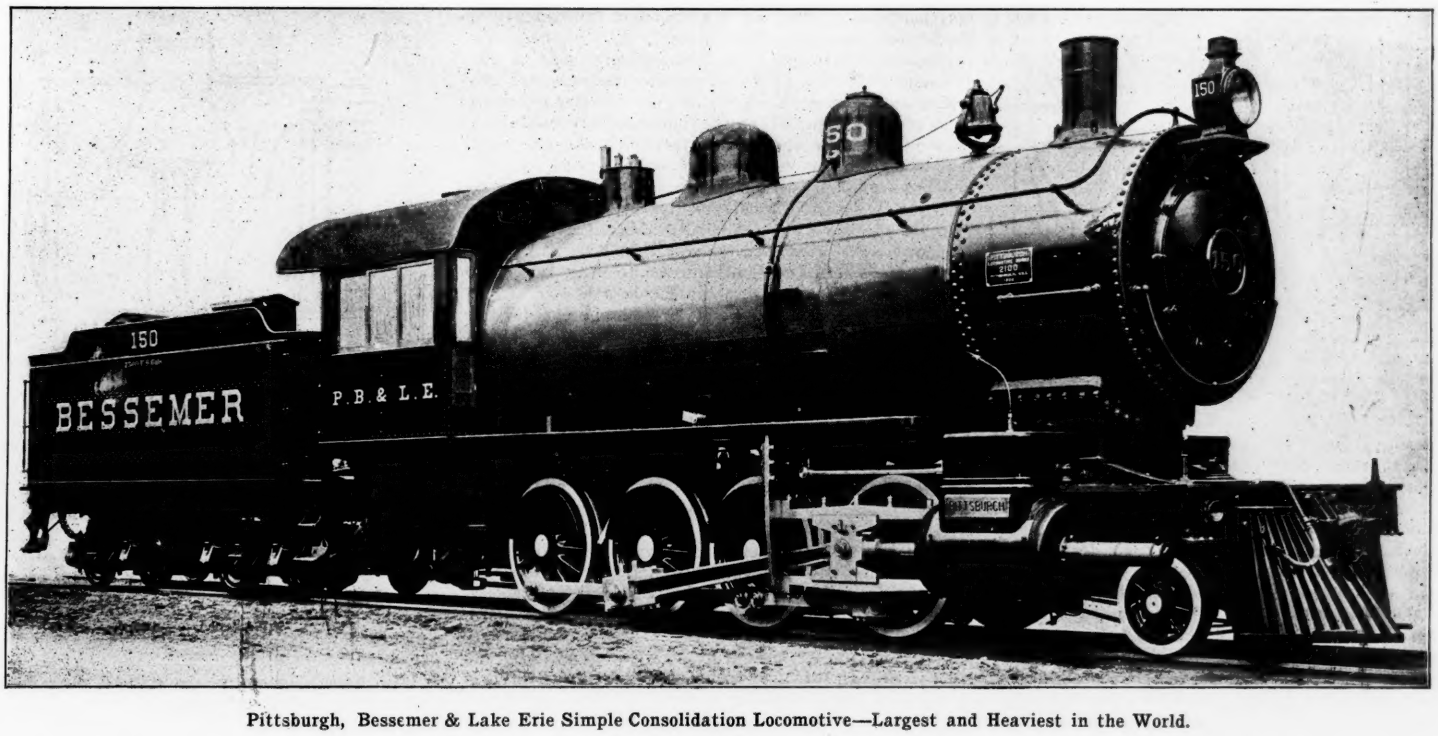
The following table gives a comparison of these engines with three others that have in quick succession held the place of honor as largest in the world.

The American Steel Castings Co. made the frames, the cast steel main wheel centers were made by the Pittsburgh Steel Foundry Co., and the cylinder heads, crossheads and rocker arms were made by the Reliance Steel Casting Co. of Pittsburgh. The tubes, 406 in number, 2¼ in. outside diameter, 15 ft. long over sheets, and made of solid drawn steel, are of uncommon interest. Likewise, the bore of cylinders 24 in.; thickness of barrel of boiler 1 in., and its diameters of 84 in. and 88 in., at front and throat sheets respectively, are especially noteworthy. The boiler is, naturally, the first point of interest in such a structure; second to that is the distribution of its great weight. The extent to which proportions can be increased and symmetry be preserved is a matter for remark in this instance as in others of recent large building. Drawings will be published later.

While these locomotives will probably never be called upon to fill the range of speed requirements of the average freight engine, yet it is interesting to compare the conclusions of the committee of the Master Mechanics' Association reporting in 1897 on ratios of grate area, heating surface and cylinder volume, with the ratios for those quantities existing in these engines. For passenger and freight locomotives, burning bituminous coal, the conclusions of the committee were that ratios should not be less than the following: Square feet of grate area to cubic feet total cylinder volume, 3 to 1; square feet of heating surface to cubic feet of total cylinder volume, 200 to 1; heating surface to grate area, 60 to 1. In the order named, the ratios in the Pittsburgh, Bessemer & Lake Erie locomotives are 2.2 to 1; 227 to 1; and 103.4 to 1. Except in the case of heating surface to grate area, which has been largely increased, it is satisfying to see that the recommendations of the Master Mechanics' committee of 1897 have been so closely followed throughout the time intervening, and that they should be so closely observed in this latest heavy design. A general description of the locomotive follows:

Comparison of Heaviest Locomotives.

Name of railr'd	Pittsb'gh, Bessemer & Lake Erie.	Union Railroad.	Illinois Central.	Lehigh Valley.
Name of builder	Pittsburgh	Pittsburgh	Brooks	Baldwin
Size of cylinders	24 x 32 in.	23 x 32 in.	23 x 30 in.	18 & 30 x 30"
Total weight...	250,300 lbs.	230,000 lbs.	232,200 lbs.	225,082 lbs.
Weight on drivers........	225,200 lbs.	208,000 lbs.	193,200 lbs.	202,232 lbs.
Total weight of engine and tender........	391,400 lbs.	334,000 lbs.	364,900 lbs.	346,000 lbs.
Tractive power based on 25% of adhesive weight........	56,300 lbs.	52,000 lbs.	48,300 lbs.	50,558 lbs.
Net hauling capacity on level	7 847 tons	7,261 tons	6,717 tons	7,049 tons
Ratio of tr'ctive power to adhesive weight as............	1 to 4	1 to 4	1 to 4	1 to 4
Percentage of efficiency, P. B. & L. E. being the unit	100	92.5	85.6	89.8



Pittsburgh, Bessemer & Lake Erie Simple Consolidation Locomotive—Largest and Heaviest in the World.

General Description.

Type ....Consolidation
Road number 150
Gage of track ....4 ft. 8½ in.
Kind of fuel used..........................Bituminous coal
Weight on drivers..............................225,200 lbs.
Weight on truck wheels..........................25,100 lbs.
Weight total ....250,300 lbs.
Weight of tender, loaded.......................141,100 lbs.
Weight total of engine and tender...............391,400 lbs.

Dimensions.

Wheel base, total of engine.....................24 ft. 4 in.
Wheel base, driving.............................15 ft. 7 in.
Wheel base, total of engine and tender........57 ft. 11¾ in.
Length over all, engine.......................41 ft. 1½ in.
Length over all, total, engine and tender.........68 ft. 0 in.
Height, center of boiler above rails...............9 ft. 8 in.
Height of stack above rails.......................16 ft. 0 in.
Heating surface, fire-box.........................241 sq. ft.
Heating surface, tubes..........................3,564 sq. ft.
Heating surface, total..........................3,805 sq. ft.
Grate area.......................................36.8 sq. ft.

Wheels and Journals.

Drivers, number.......................................Eight
Drivers, diameter ....54 in.
Drivers, material; front, intermediate and back, centers ....Steeled cast iron
Drivers, material; main centers........................Cast steel
Truck wheels, diameter.................................30 in.
Journals, driving; front, intermediate and back....9 x 13 in.
Journals, driving; main...........................10 x 13 in.
Journals, engine truck.............................6 x 12 in.
Main crank pin, size..............................7½ x 8 in.

Cylinders.

Cylinders, diameter ....24 in.
Pistons, stroke ....32 in.
Piston rods, diameter..................................4½ in.
Piston rods and valve stem packing...................Metallic
Main rod, length, center to center...................118⅝ in.
Steam ports, length....................................20 in.
Steam ports, width.....................................1⅝ in.
Exhaust ports, length ....20 in.
Exhaust ports, width ....2¼ in.
Bridge, width ....1½ in.
Cylinders and valves oiled by sight feed lubricator.

Valves.

Valves ....Balanced
Valves, greatest travel ....6 in.
Valves, outside lap ....1 in.
Valves, inside lap or clearance...........................0
Valves, lead in full gear.............................1-10 in.

Boiler.

Boiler, type of ....Straight with sloping back end
Boiler, water test....................................330 lbs.
Boiler, steam test....................................240 lbs.
Boiler, working pressure..............................220 lbs.
Boiler, material in barrel.......................Carnegie steel
Boiler, material in barrel, thickness....................1 in.
Boiler, diameter of barrel at front sheet...............84 in.
Boiler, diameter of barrel at throat sheet..............88 in.
Boiler, diameter of barrel at back head...............81½ in.
Seams: kind of....horizontal, butt joint, double welted, sextuple riveted.
Seams: kind of....circumferential, double riveted.
Thickness of tube sheet.................................⅝ in.
Dome, diameter ....32 in.
Safety valves: two 3 in. open pops and one muffler.
Water supplied through two No. 12 injectors.
Crown sheet supported by radial stays.

Tubes.

Tubes, number 406
Tubes, diameter outside................................2¼ in.
Tubes, length over tube sheets.....................15 ft. 0 in.
Tubes, material ....Solid drawn steel

Fire-Box.

Fire-box, length ....132 in.
Fire-box, width ....40¼ in.
Fire-box, depth at front end..........................82⅞ in.
Fire-box, depth at back end...........................70⅞ in.
Fire-box, material....................Carnegie fire-box steel
Fire-box, thickness of sheets, crown.................7-16 in.
Fire-box, thickness of sheets, sides and back...........⅜ in.
Fire-box, thickness of sheets, tube.....................½ in.
Fire-box, water space: width, front, 4 in., back 4 in., sides 4 in.
Grates, cast iron, rocking pattern.

Smoke-Box.

Smoke-box, diameter...................................85¼ in.
Smoke-box, length from tube sheet to end..............68⅝ in.

Other Parts.

Exhaust nozzle ....Single
Exhaust nozzle, diameter ....5¾ in.
Exhaust nozzle, height ....On center line
Smoke stack ....Taper
Smoke stack, least diameter............................17 in.
Smoke stack, greatest diameter.........................18 in.
Smoke stack, height above smoke-box....................33 in.
Track sander ....Pneumatic
Power brakes ....Westinghouse-American

Tender.

Type ....Eight wheeled with swivel trucks
Tank capacity, water..........................7,500 gallons
Tank capacity, coal..................................14 tons
Kind of material in tank...............................Steel
Type of under-frame.........................Steel channels
Type of truck ....Rigid bolster, diamond
Type of truck springs.......................Double elliptic
Diameter of truck wheels...............................33 in.
Diameter and length of axle journal...............5½ x 10 in.
Distance between centers of journals...................77 in.
Diameter of wheel fit on axle..........................6⅞ in.
Diameter of center of axle.............................5⅞ in.
Length of tender frame over bumpers...............25 ft. 0 in.
Length of tank....................................23 ft. 6½ in.
Width of tank......................................9 ft. 10½ in.
Height of tank, not including collar...................65 in.
Height of tank, including collar.......................81 in.
Type of back drawhead, M. C. B. coupler and Westinghouse Friction Draft Gear.

Some New English Passenger Cars.

The Great Western Railway of England has just put in service on its line between London and New Milford, the route of the fast Irish express trains, a train of new cars, which, according to *Transport*, are a "leetle" the best cars now running in England; and their leading feature, aside from the luxury of the appointments in every detail, is a central "gangway," which extends throughout the length of every car in the train. In other

words, the American custom has been adopted, and the corridor along the side of the car, which has heretofore served in European car building as the substitute for the American central passage, is, by implication, rejected. As it does not appear, from any statement in the account before us, that the American plan of seats has been adopted entire, we assume that the compartment idea is retained, though it is said that the partitions do not extend to the roof. The train has no dining car, but light refreshments are served from a "kitchen car," and adjustable tables are made available for every passenger in the train, an electric button being provided at each seat. The cutting off of the partitions before they reach the roof would seem to indicate a trace of a leaning toward the American practice of having no partitions at all. Probably the same Yankee who rides in one of these cars will suggest that the guards carry on the train a handsaw and cut down the partitions an inch at a time, and thus gradually convert the English passengers into good Americans —while they are on the Great Western.

Exhaust and Draft in Locomotives.

On the subject of exhaust and draft devices for locomotives conclusions reported to the International Railroad Congress by Messrs. C. H. Quereau and Edouard Sauvage were published in the *Railroad Gazette*, January 19, p. 32, and May 25, p. 332. The report of Mr. Sauvage is for all countries except the United States, Sweden, Norway, Denmark and Russia, but contains frequent reference to practice in the United States. The issue of January 19 includes a concise summary of American practice as condensed from many letters received by Mr. Quereau while preparing his report. Bearing further upon the matter published there follow portions of the report of Mr. Sauvage. These comprise expressions of opinion from various railroad managements, on relative values of fixed and variable exhaust nozzles and smoke

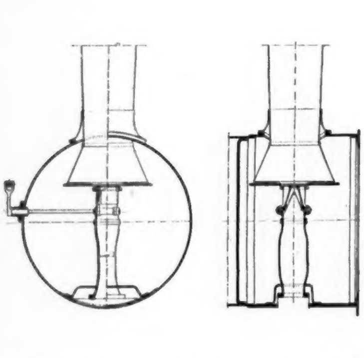


Fig 1.—Variable Blast Pipe—French Northern Railway.

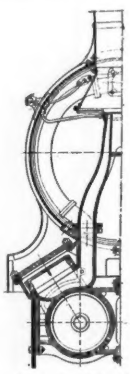


Fig. 2.—Fixed Vortex Blast Pipe—French Western Railway.

stacks, illustrations of devices used, consideration of spark arrestors and of heating feedwater.

Mr. Sauvage states the qualities of a good blast pipe and the difficulties of obtainment as follows:

It produces, when necessary, a very strong draught, or a weaker one, as required; the draught is a uniform and regular one (it appears very difficult to satisfy this condition if the locomotive moves at a low speed); much cinder is not carried off by the current of hot gases; the combustion is uniform over the whole surface of the grate (except in the case when the fuel is systematically fed in so as to form a thicker layer at the back); and the hot products of combustion pass equally through all the tubes. Finally the draught (even a strong one) is obtained without any considerable increase in the back-pressure of the cylinders.

The arrangements necessary in order to obtain these results or at least approximate to them are unfortunately not known with any certainty. Moreover they must vary with different conditions, such as the area of the grate, the nature of the fuel, and the proportions of the boiler. In spite of many important experimental and theoretical researches into the question, the apparatus is often arranged according to purely empirical rules of a haphazard nature.

A closely condensed synopsis of opinions upon the adaptability of the fixed and variable exhaust nozzle tip, received by Mr. Sauvage, is here given: The management of the London & Northwestern Railway finds the variable exhaust pipe difficult to keep in order. Glasgow & Southwestern, adjustable blast pipes of little practical value as blast orifice can in most cases be permanently fixed within 1/8 in. of size most desirable. Metropolitan Railway, best results are obtained with as large fixed blast pipe as circumstances will permit, and depend upon the skill of firemen; it is conceded that for long distance with varying loads and gradients there is advantage in the variable blast pipe. East Indian railways, variable blast pipe better than fixed one if intelligent use could be insured; experience is that the smaller orifice is so constantly used that when change is desired apparatus will not move. Central Argentine railway, there would be no advantage to them in use of variable blast and the device is practically impossible to keep in good working order. Buenos Ayres Great Southern railway, a variable exhaust unnecessary. Dutch railway recognizes theoretical value of variable blast pipe but there are additional complication and misuse by firemen with loss of fuel from excessive draft. Austrian Northwestern finds fixed blast pipe most advantageous. Adriatic System in Italy expresses preference for fixed blast pipes, although its locomotive engineers prefer variable blast pipes. Mediterranean System, in Italy, finds advantage in the variable blast pipe for locomotives running on lines with varying curves and gradients. Belgian National Light railroads use variable blast pipe exclusively. French Northern railroad employs almost entirely the variable blast pipe with valves, as it is found expedient to force the blast upon heavy grades with fast and heavy trains; this applies particularly to compound engines. The Orleans asserts that variable blast pipes afford greater control of fire and economy in fuel, with adaptability to conditions of weight, speed, and gradients. French Eastern prefers variable blast pipes but admits that delicate handling is required. Expression from the Paris, Lyons & Mediterranean coincides with the preceding opinion. Madrid, Saragossa & Alicante finds advantage in variable blast pipes when medium quality of fuel is used, but reports rapid deterioration of fireboxes and tube sheets in the absence of careful usage by engineers. Spanish Northern railroad finds variable blast pipe of great advantage and has replaced fixed vortex blast pipes with them after trial of the vortex pipe upon several locomotives. Roumanian State railroad finds the variable blast pipe of special use on passenger locomotives but remarks misuse of the device by engineers. French Southern has never used fixed blast pipe, but has been obliged to limit the action of valves in variable blast pipes on the Bordeaux-Bayonne line in times of drouth, because of the risk of forest fires. The restriction of the draft and exhaust was apparent in the weakened action of the locomotive at such times.

Commenting upon the foregoing expressions Mr. Sauvage says in part:

The variety of these opinions shows how difficult a definite solution of the question is. It proves that in many cases any one definite system may not be the best one, and that all the circumstances must be considered in order to make a judicious choice. It will be observed that several partisans of the variable system acknowledge that the system is not free from faults.

A variable blast pipe on a given locomotive may be put, as compared with a fixed one, to two different uses: The orifice may be enlarged when it is not necessary to obtain much steam, and it may, on the contrary, be reduced when more steam is required. The variable blast pipe may thus be used to reduce the draught, or to increase it. The first proceeding may be the only one arranged for (Macallan's variable blast, Fig. 20, and the bypass arrangement, Fig. 19, of some French Northern locomotives). If the locomotives are often used for very light work and if the drivers make the simple adjustment necessary properly, fuel must evidently be economized. In the case of the fixed blast pipe, the draught may be reduced by closing the doors of the ashpan; but in that case there is risk of reducing the supply of air too much, and consequently unburnt combustible gases may escape.

On the other hand, reducing the orifice increases the yield of the engine, but does not lead to any economy of fuel; it may even increase it, uselessly, if such reduction is made improperly. This can, however, be prevented to a certain extent, by arranging the mechanism so that the clear passage way of the steam can never be reduced excessively.

If we take into consideration the varying conditions of different lines, and if we bear in mind that the variable blast pipe is easily choked up, requires to be kept properly in order, and must be handled with care and skill in order to be really useful, we realize easily how certain managements prefer to keep to fixed blast pipes. Speaking generally, it must not be forgotten that any adjusting device is also a disadjusting one; so that in practice one must not confine oneself to estimating the intrinsic worth of any piece of apparatus, but must also consider the personal equation of those who are to use it. The fixed blast pipe is almost always in use in Great Britain; this is partly due to the nature of the fuel which is generally used. On the Continent, locomotives are frequently fitted with variable blast pipes.

Section and Shape of the Orifice of the Blast Pipe.

With a fixed blast pipe, the section of the orifice is frequently determined by trials or from results obtained by locomotives in actual use; sometimes the orifice consists of a piece which is easily replaceable. The sections of the orifice of the variable blast pipe often vary within very wide limits. In fixing its dimension, the smallest admissible one should be determined with more care than is usually bestowed upon it; for if the orifice is unduly reduced, the back pressure on the pistons becomes too great, often without material increase of draught.

The orifice of the variable blast pipe with flap valves (Fig. 1) is rectangular.

Sometimes the orifice is annular (Figs. 2, 3 and 4) and the hot gases are drawn along inside and outside the annular steam jet. This is known as the "vortex" blast pipe. It is generally admitted that an annular orifice gives a better draught than a circular orifice of the same area.

The French Northern, who put into use several Adams vortex blast pipes in 1887, however, states that this arrangement is not altogether regarded with favor by their drivers, who often observe that the orifice becomes choked. Be that as it may, the company has recently applied these blast pipes furnished with bypasses to twenty locomotives (Fig. 19).

The French Western has also observed that vortex blast pipes become choked up rapidly and irregularly. It is more particularly the back part of the orifice which becomes choked (Fig. 5), at least in the case of the arrangement shown in Fig. 3. The deposit is not so irregular in the case of the arrangement shown in Fig. 2. Fig. 6 shows an arrangement in which the steam is admitted tangentially to the vertical pipe, in order to distribute it more uniformly in the blast pipe.

The improvement in the draught which results from the use of the vortex blast pipe does not depend merely on the greater quantity of gas drawn through, but also on the fact that such gas is more uniformly distributed through the tubes; this effect results from the draught produced in the lower tubes by the central part of the apparatus.

In the case of a circular orifice the section available for the outflow of steam may be modified by the addition of a wedge-shaped cross-piece fixed on one diameter of the circular opening. That cross-piece makes the jet of steam spread. According to the results obtained by Mr. von Borries, this arrangement is specially useful with a straight exhaust-pipe, as in the case of a locomotive with inside cylinders; in such a case the jet spreads but little. On the other hand, with two separate pipes, uniting close to the orifice, the cone formed by the steam is more spread out. The addition of such a cross-piece supplies, according to Mr. von Borries, a simple means for improving the draught of certain locomotives having fixed circular blast pipes. But, according to the results obtained by the American Master Mechanics, that crosspiece has no useful effect. That divergence of opinion shows how complex the problem is.

During a long period in America, the orifice of the blast pipe was divided into two separate portions, each exhaust pipe being continued separately to the orifice. Consequently, neither of the two resulting jets of steam was coaxial with the axis of the chimney. This arrangement seems rarely adopted in recent locomotives.

The shape of the pipe is generally simple. When fixed, it often has the shape of a diminishing cone (Fig. 7). The convergence is sometimes much accentuated at the upper end. Sometimes the pipe is nearly cylindrical (Fig. 8). In Fig. 9 a nozzle piece is shown, which consists of a

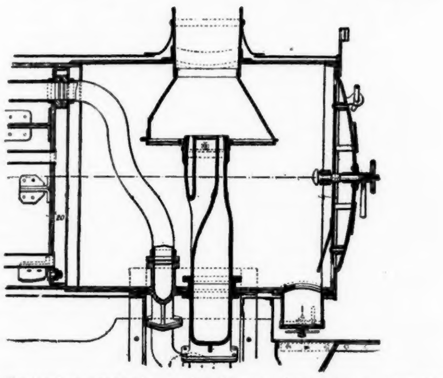


Fig. 3.—Extended Smokebox with Vortex Blast Pipe—French Western Railway.

diminishing cone, a cylinder, and a diverging cone; the height of those cones is so small that it does not seem probable that the steam will follow the continuation of the latter one.

The exhaust pipes are generally arranged so as to be at first of a constant section, which is further on gradually reduced; furthermore one tries to arrange them so as to obstruct the boiler tubes as little as possible. A very simple exhaust pipe used on locomotives with inside cylinders is shown in Fig. 7.

With outside cylinders, the exhaust pipes have sometimes sudden bends, and the pipes of the two cylinders do not always join conveniently. According to Mr. von Borries, however, these sudden bends should produce a useful spreading of the stream of exhaust.

The top of the blast pipe is frequently cored to form a perforated pipe through which the blower steam passes (Fig. 10); a ring pipe of larger diameter is sometimes used for the exhaust of vacuum brake ejector (Fig. 10 shows a central pipe arranged for this purpose). These projections, or the larger ones of the joint securing the upper portion of the blast pipe, are not apparently feared as obstructions to the free movement of the gases. Possibly a better result would be obtained by doing away with any such obstructions as far as possible.

Fig. 11 shows a cored ring for the blower, which, although cast in one piece with the blast pipe, is at some distance from its edge.

Section, Height and Shape of the Chimney.

The dimensions of the chimneys and of the blast pipes of most locomotives have been arrived at empirically. It appears to be advantageous to make the chimneys of not too large a diameter; in the case of locomotives built recently, the area of the chimney section has not been increased in the same ratio as the grate area. When the chimneys are too large, the draught is bad, no doubt because the height is too short for the diameter. Locomotives of the Belgian State form an exception to the general practice, as they have huge square chimneys of much larger section at the bottom. These chimneys are fitted to locomotives having very large grates for burning slack. A point of some interest is the use of screens or shields which protect the forward portion of the upper opening of the chimney. These shields increase the draught slightly at high speeds. They are not suitable for engines running regularly in both directions, in which case they must be movable. These shields are more specially used by the Belgian State, the French State,

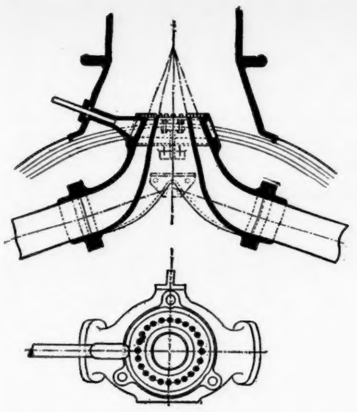


Fig. 4.—Fixed Vortex Blast Pipe—Austrian Northwestern Railway.

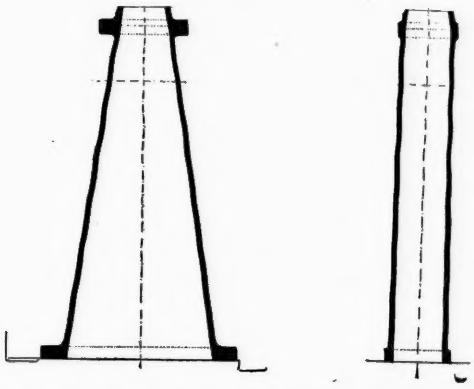


Fig. 7.—Lancashire & Yorkshire—Fixed Blast Pipe.

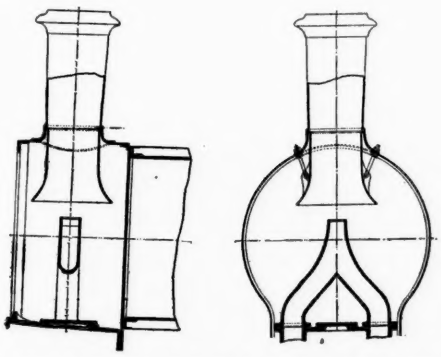


Fig. 8.—Fixed Blast Pipe—London & Northwestern Railway.

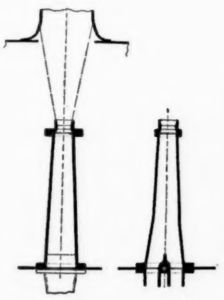


Fig. 9.—Fixed Blast Pipe—New Zealand Government Railways.

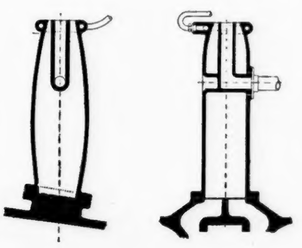


Fig. 10.—Fixed Blast Pipe—Midland Great Western Railway of Ireland.

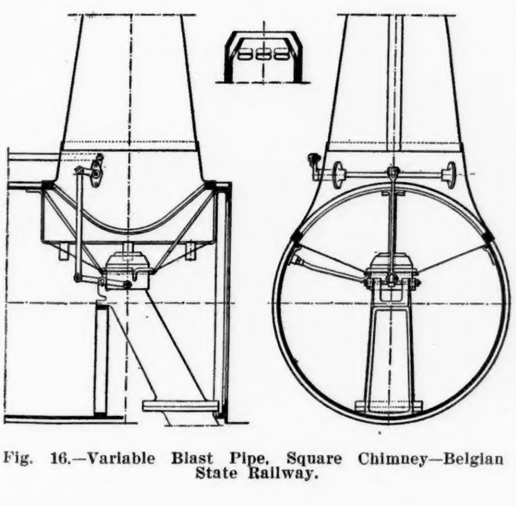


Fig. 16.—Variable Blast Pipe, Square Chimney—Belgian State Railway.

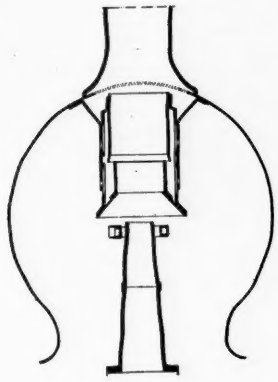


Fig. 12.—Fixed Blast Pipe—English Great Northern Railway

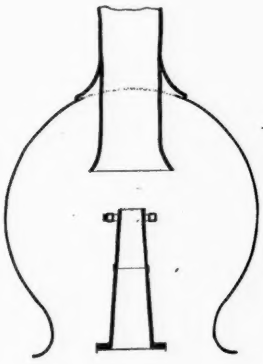


Fig. 11.—Fixed Blast Pipe—Great Northern Railway of England.

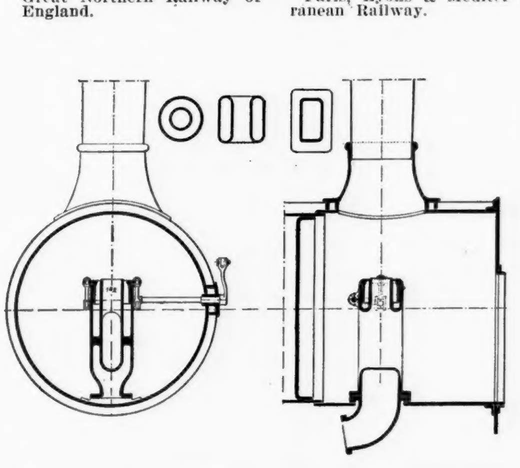


Fig. 18.—Variable Annular Blast Pipe—Italian Mediterranean Railway.

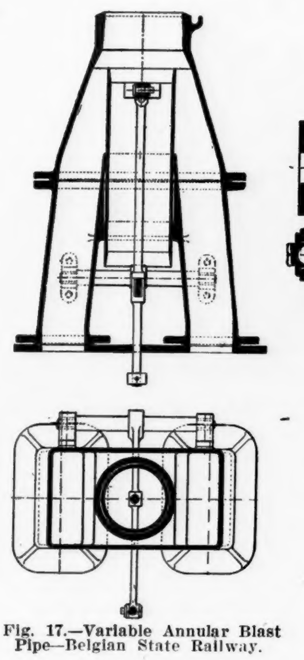


Fig. 17.—Variable Annular Blast Pipe—Belgian State Railway.

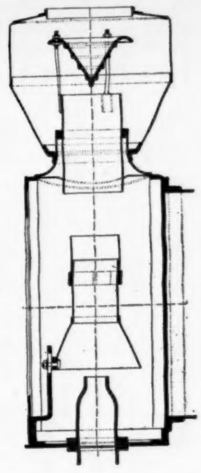


Fig. 13.—Fixed Blast Pipe—New Zealand Government Railways.

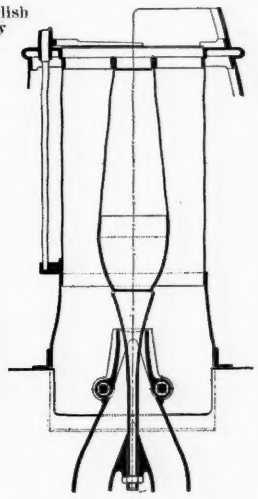


Fig. 14.—Variable Blast Pipe—Paris, Lyons & Mediterranean Railway.

Fig. 5.—Vortex Blast Pipe Obstructed—French Western Railway.

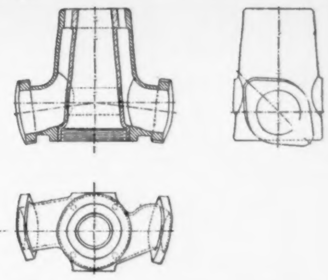


Fig. 6.—Fixed Vortex Tangential Admission—Austrian Northwestern Railway.

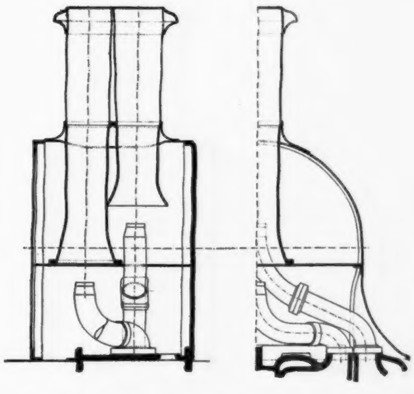


Fig. 15.—Webb's Double Blast Pipe—London & Northwestern Railway.

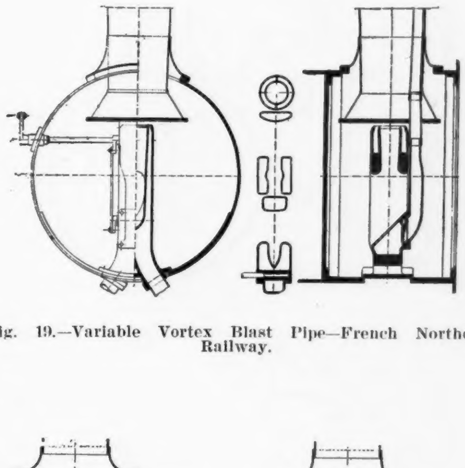


Fig. 19.—Variable Vortex Blast Pipe—French Northern Railway.

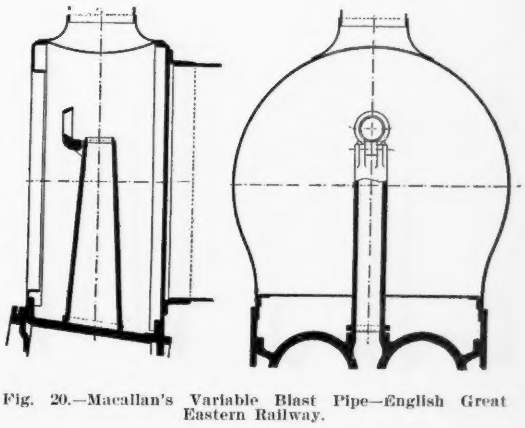


Fig. 20.—Macallan's Variable Blast Pipe—English Great Eastern Railway.

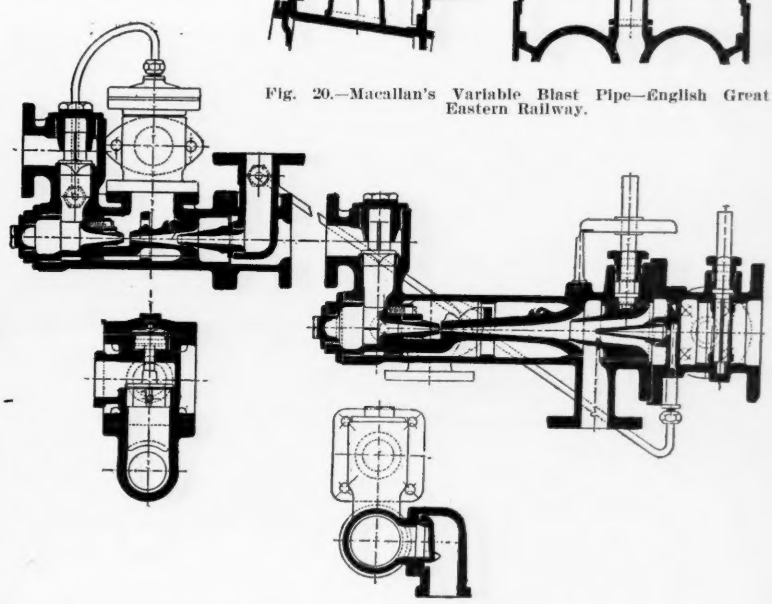


Fig. 24.—Davies' & Metcalfe's Exhaust Steam Injector.

Various Exhaust and Draft Appliances.

the Paris, Lyons & Mediterranean and the French Northern Railways.

Position of the Orifice.

The blast pipe of old locomotives often reached into the chimney; that arrangement seems to have been given up, and a general approach to the practice long observed in England has been made. This practice consists in placing the orifice of the blast pipe slightly higher than the top row of tubes. The chimney is frequently more or less prolonged downwards to the interior of the smoke box in the form of a cone, but the orifice is sufficiently distant from the narrowest part.

Many locomotives, the draught of which was deficient, have been improved by altering the position of the orifice of the blast pipe and placing it at a suitable height.

The orifice may even be lowered considerably by following an arrangement, formerly much used in America; in this a petticoat must be fixed. This plan has the defect of somewhat obstructing the smoke-box.

This arrangement is being tried on the Great Northern Railway (Fig. 12), who have copied the pattern used on the locomotives of the Michigan Central Railroad (see *Railroad Gazette*, June 11, 1897.) The first results are satisfactory.

The New Zealand Government Railways have locomotives of American type with the blast pipe placed very low down and a petticoat fixed over it (Fig. 13).

Deflector Plates in the Smokebox.

In America a deflector plate is often placed in the smokebox in front of the tubes so as to deflect the gases toward the lower portion of the smokebox. This arrangement has been in use in Europe for some years. The deflector plate induces the furnace gases to pass through the lower tubes which otherwise often have a tendency to become choked.

The Belgian State is making a trial of this arrangement on a six-wheel coupled locomotive with wheels 1.30 meter (4 ft. 3 3-16 in.) diameter (type 25); movable doors together with a plate fixed to the smokebox tubeplate, cover the upper 10 rows of tubes when shut; these doors are at a distance of 180 millimeters (7 1-16 in.) from the tube-plate. This locomotive already had a vortex blast pipe, which also promotes the draught through the lower tubes. The trials show that the deflector plate greatly reduces the accumulation of cinders in the smokebox; the small pieces of coal are more completely burned up in the firebox. The flames, instead of being drawn towards the central portions of the upper rows of tubes are distributed more evenly over the whole of the tubes, and it is easier to keep the fire clear and uniform. These first satisfactory trials will be followed up.

The French State Railroad has also tried deflector plates in the smokeboxes of various express and goods locomotives; favorable results have been obtained from these trials. The quantity of cinder carried over (whether accumulating in the smokebox or thrown out of the chimney) is reduced to half, without interfering with the combustion. A slight economy in fuel (2.4 p. c.) has apparently been obtained in the case of locomotives with large grate area. No appreciable economy has been found in the case of old locomotives with small grate area. These results have led the French State Railroad to apply deflector plates to smokeboxes in a number of cases.

On the other hand, German experiments on blast pipes (*Bulletin of the Railway Congress* for July, 1897, p. 911) show somewhat unfavorable results; it was found that deflector plates interfered with the movement of the gases and required a more vigorous blast; as the gases were directed towards the bottom of the smokebox, eddies were set up which carried cinders away through the chimney.

Various Special Arrangements.

The Paris, Lyons & Mediterranean has for some years used blast pipes with central cores (Fig. 14), which fill the central portions of rather large chimneys. The blast pipe reaches to within the chimney. This arrangement gives good results.

We may here refer to Kordina's ingenious arrangement, which was tried in Hungary and on the French Northern Railway. This arrangement consists of two concentric pipes, each connected with one of the cylinders. The inventor hoped that one exhaust would produce suction in the other pipe and so reduce back pressure in the cylinders. Some indicator diagrams seemed to show this reduction of back pressure; nevertheless the apparatus has not been further developed.

In order to equalize the distribtuion of the gases through the tubes, Mr. Webb has recently divided the smokebox into two parts separated by a horizontal plate, each part being fitted with a separate chimney and special blast pipe (Fig. 15). This arrangement has been adopted on two passenger locomotives, one compound and the other non-compound, with wheels 2.12 meters (7 ft.) diameter. According to the particulars supplied by Mr. Webb, the system worked well on the non-compound locomotive, with increase of steam raising power. No apparent advantage was obtained in the case of the compound locomotive which had only half the number of beats. The sketch shows that the non-compound locomotive had four cylinders, each blast pipe being in connection with two cylinders. On the other hand, in the compound, each blast pipe only received steam from a single cylinder.

Arrangement of Variable Blast Pipes.

The most usual arrangement is to have two flap valves, each with a spindle (Fig. 1). Certain precautions are necessary to insure proper working; the valves must be firmly fixed on their spindles, and at the same time they must be easily removable, because the blast pipes rapidly become choked; the controlling gear should be arranged so that the two valves are always placed symmetrically to the axis of the chimney. An arrangement with right and left hand screws acting on levers carried by the valve spindles meets the requirements, provided that they are carefully set.

The Belgian State Railways have an adjustable arrangement (Fig. 16); the blast pipe terminates in a cylindrical portion surmounted by a short perforated cone; a sleeve is fitted on the cylindrical part and covers the upper portion of the cone. As shown in the detail sketch, the outer sleeve is raised and the opening of the slots in the conical portion of the fixed blast pipe is effected, so that a larger area of orifice is available. The Belgian National Light Railroads use a similar apparatus known as the "Riga" blast pipe.

The Belgian State Railroads also use a variable annular blast pipe with sliding sleeve (Fig. 17); the area of the orifice is reduced when the central cylinder is raised. This arrangement compares with that shown in Fig. 18.

Some of the locomotives of the French Northern have been fitted with the Adams vortex blast pipe, made variable by the addition of a bypass fitted with a valve which can be opened to a greater or less extent (Fig. 19). The bypass pipe is placed against the back of the inside of the chimney. This arrangement allows the draught to be checked, particularly when starting. Reference should be made to Macallan's variable blast pipe (Fig. 20); the movable hinged top when raised to the position shown in the figure gives a larger opening.

Following the above recital and exhibits is some reference to trials of the different methods, setting forth, chiefly, the wide divergence of American and German conclusions in the shaping and treatment of exhaust-nozzle tips. The treatment of front-end nettings and extended front ends in their relations to the arrest of sparks, and the obstruction offered to draft, contains nothing essentially new. The devices used are various forms of netting, the chief points of difference being that some nettings were fixed vertically, some horizontally and others at various compromising angles.

Among the many references to the heating of feed-water by exhaust steam, the following are most noteworthy:

Lencauchez's apparatus is used on certain locomotives of the Orleans Railroad.

Körting's compound injector is a double injector arranged to work with very hot water (up to 70° C. or 158° F.); the water from the tender passes through a tubular heater which receives exhaust steam.

Strong's heater consists of a receiver through which the water passes, and in which it is heated by a number of tubes receiving exhaust steam, and also by a number of tubes through which direct boiler steam passes; the deposited salts are separated by a filter. If an injector is used, the water is already very hot when it gets there, and not much heat can be taken from the exhaust steam.

A tubular heater, through which the water is pumped, is used on American locomotives. (*Rushforth—Ed.*)

For some years past, several managements have used Davies and Metcalfe's exhaust injector (Fig. 24), more particularly in Great Britain; among them are the North Eastern, the Great Northern, the Great Western, and the North British.

In 1897 the mean coal consumption on 14 locomotives of the North Eastern was reduced from 37.1 to 34.4 lbs. per mile through the use of this apparatus. It has been fitted experimentally to two locomotives of the French Western Railway.

The observations made on these two locomotives show that the water was heated in the first injector from 12° C. to 60° C. (53° to 140° F.), but this heating was not entirely due to the exhaust steam, because the first injector is always supplied in addition with a small quantity of steam from the boiler.

According to the information received by the reporter, trials of the Davies and Metcalfe injector are also being made on the Belgian State Railways, the Dutch Railroad and the New Zealand Government Railroads.

The total condensation of exhaust steam in the tanks of tank engines on some underground lines should also be mentioned here. As this heated water is used as feed in the pumps, a portion of the heat of the exhaust is utilized; but the greater portion of the heated water is thrown away and replaced by cold water after a run of a few miles. This condensation is a method which enables certain lines in towns to be worked by ordinary locomotives; but it is a system which is far from being economical in fuel.

The arrangement is in use in London on the Metropolitan and Metropolitan District Railroads, and on the other companies' trains which run on those lines; in Liverpool, on the Mersey Railroad; in Glasgow, on certain locomotives of the Caledonian Railway; and in Paris, on some locomotives of the Orleans & Western.

The body of the report concludes by a reference to the arrangements for feed-water heating described in the *Railroad Gazette*, p. 265, 1897, and pp. 808 and 815, 1898.

Railroad Telegraph Superintendents' Convention.

The nineteenth annual convention of the Association of Railway Telegraph Superintendents was held at Detroit on June 20, 21 and 22. It is regarded as having been the most important meeting so far held, whether considered in numbers present, interest shown or work accomplished. The proceedings were marked throughout with a dignity and earnestness of purpose.

President L. B. Foley, of Detroit, called the meeting to order at 10 o'clock Wednesday morning. Secretary-Treasurer P. W. Drew showed a good cash balance on hand. Following this came the election of new members, one of whom, Mr. F. H. Valentine, of the New York, New Haven & Hartford, bears the title of Superintendent of Telephone. The other features of the morning session were papers by Charles Selden (B. & O.), Charles F. Annett (Illinois Central), and Henry W. Pope, General Manager of the Bell Telephone Company, Buffalo. The general theme of these contributions was the use of the telephone by the railroads as an auxiliary to the telegraph. At the afternoon session a resolution was adopted expressive of sorrow in the death of William J. Holmes, late Superintendent of Telegraph of the Erie Railroad. Article 3 of the Constitution was made to read: "Any one connected in official capacity with the telegraph, telephone, signal, electric light or power departments upon a railroad, may become a member of this association by subscribing to the Constitution and paying into the treasury the sum of five dollars per annum, and receiving a majority vote of a quorum present."

There was a further discussion of the telephone in its relation to the railroads. Mr. A. A. Robinson, of the Central Union Telephone Company, Chicago, gave an outline of what his company was willing to do to meet the demands of the railroad companies. Mr. George L. Lang, of Lexington, Ky., read some interesting "Reminiscences of an Old-Time Telegrapher," written by Mr. Joseph B. Tree, Superintendent of Telegraph of the Western Union at Richmond, Va.

The first business on the second day was the election of officers. Vice-President W. F. Williams, Superintendent of Telegraph of the Seaboard Air Line, Portsmouth, Va., was elected to the Presidency; C. F. Annett, of the Illinois Central, Chicago, Vice-President; and P. W. Drew, of the Wisconsin Central Railroad, Milwaukee, was continued in the position of Secretary and Treasurer he has so long and faithfully filled. The next place of meeting is Boston, Mass., and the time June 19, 1901.

Then came a paper on "The Storage Battery for Telegraph Use," J. H. Jacoby (L. V.), South Bethlehem.* The paper was discussed by Messrs. Lang (C., N. O. & T. P.), Darlton (Southern), Selden (B. & O.), I. N. Miller, of Cincinnati, and William Maver, Jr., of New York. Mr. H. T. Simpson (C. & O.) read a paper on "Block Signals."* This was discussed by Messrs. Darlton, Walstrum (N. & W.), Kinsman (Wabash), Rhoades (C., C., C. & St. L.), Lang and Jacoby (L. V.). The next paper to be read was on "Automatic Crossing Alarms," by J. S. Evans (N. Y. C. & St. L.)* This paper brought out a discussion by Messrs. U. J. Fry (C., M. & St. P.), Selden and Rhoades.

On the third day Mr. William Maver, Jr., of New York, read a paper on "The Electrical Condenser, and Some of Its Uses in Telegraphy."*

Mr. Maver's paper was highly interesting, and was discussed at length by Messrs. Jacoby and Miller. Mr. W. W. Ryder (C., B. & Q.), discussed the question of low resistance relays, which are now giving such general satisfaction on the various railroads of the country. Mr. Kinsman offered some suggestions to operators handling switchboards.

An earnest recommendation was made by Mr. Selden (B. & O.) that a censorship of railroad messages might be had in order to reduce the amount of unnecessary railroad telegraphing, which is now the subject of universal complaint. Mr. Kinsman thought that the improvement of the railroad mail service would tend to overcome the trouble cited.

Mr. George M. Dugan explained the use of underground cables for track crossings on the Illinois Central. Some of the cables have been in use for five years.

EXHIBITS.

J. H. Bunnell & Co., 20 Park Place, New York.—Very handsome exhibit of specialties. Their new main line sounding relay, MCM model, has adjusting nuts conveniently located on the front of instrument, with an indicator that shows at a glance the distance between armature and magnet cores. The new form of Wheatstone Bridge, called the Jones type, has no contact plugs, resistance being thrown in and cut out by means of radial switches having platinized contacts. There was a new form of pony relay with adjustable magnets as souvenirs.

Bunnell & Co. also exhibited a model of a new form of steel pole for electric wires, made by the Tripartite Steel Pole Co. of New York. This pole is made of three U-shaped steel ribs, held together at suitable distances by intersecting braces. It can be shipped in sections, and put together on the ground. Bunnell's wire gage attracted much attention. With this gage one may determine instantly the gage of wire required to carry a given current a certain distance at any determined loss of voltage.

The Railroad Supply Co., Chicago, Ill., had a very handsome exhibit of its highway alarm, called the "Chicago Crossing Signal." This gives a visual as well as an audible signal. With this signal there is a continuous track circuit from the ringing point all the way to the crossing. Each track has an ordinary gravity battery, which works a relay located at the crossing. The exhibitors say that the signal may be used in conjunction with automatic block signals without interfering with the efficiency of either. Extra contact points on the relay may also be provided for situations where there are switching movements, so that the alarm will be silenced while the train is standing within the signal limits at the station, or elsewhere, but will automatically give the alarm again as soon as the train moves toward the crossing.

Mr. H. B. Ware, of Wymore, Neb., exhibited a battery insulator, consisting of a circular glass tray suspended between the copper and zinc elements of the battery. This device, it is claimed, increases the efficiency of the battery fully 40 per cent., and decreases the consumption of the zinc 25 per cent., and that of the blue vitriol 33 1-3 per cent. It is also a great labor saver. To clean a battery it is only necessary to remove the zinc (the glass insulator being attached to it), empty the deposit and return the zinc to its proper position.

The Bunnell Telegraphic & Electrical Co., of 110 Beek-

*Abstracts of papers deferred to a future issue.—Editor.

man street, New York, showed samples of telegraph instruments.

The Automatic Clock Co., of Chicago, exhibited automatic electric clocks and time stamps.

J. L. Cutler, of New York, exhibited a single magnet relay and sounder; it was in actual operation on a Michigan Central wire.

The Ericsson Telephone Company, 296 Broadway, New York, showed a fine display of telephones and appliances, including a complete working exchange.

The Master Car Builders' Convention.

We conclude from page 412, our issue of June 22, the report of the thirty-fourth annual meeting of the Master Car Builders' Association. Abstracts of the committee reports presented at that meeting, to which references are made in the discussions reported below, will be found in the issue of June 22, beginning on page 413.

THIRD SESSION—WHEEL CIRCUMFERENCE MEASURE.

Mr. F. A. Delano (Chicago, Burlington & Quincy)—I would like to have some explanation from the Committee as to why it selected this width of tape. The road that I am with has been using for a number of years a tape ⅝ in. wide and manufacturers tell me that the narrower the tape the better; better still in the form of a wire, the wheel being coned.

Mr. J. J. Hennessey (Chicago, Milwaukee & St. Paul)—This tape was selected because it expressed a majority of opinions recommended to the Committee.

The subject was ordered to be submitted to letter ballot.

JOURNAL BOX, BEARING, WEDGE AND LID FOR CARS OF 100,000 LBS. CAPACITY; ALSO DESIGN FOR JOURNAL BEARING AND WEDGE GAGES FOR 80,000-LB. CARS.

Mr. Wm. Garstang (Cleveland, Cincinnati, Chicago & St. Louis)—In designing this box, brass and wedge, it was our effort, knowing that there were several thousand cars running with 100,000-lbs. capacity axles and boxes, to get up a box that would interchange with the boxes already in service, and the Committee asked for drawings and suggestions from all roads that had 100,000-lb. cars and the information was used as a basis in getting up the box, brass and wedge.

The report was received and ordered submitted to letter ballot as a Standard of the Association.

Mr. F. M. Whyte—I think the box and the gages for the brass and wedges are not in shape to be adopted. I think that the gages do not cover sufficient of the fittings; that is, there should be a gage for the box. There is a gage now for the brass which does not cover the brass entirely. It should be added to, and I think that unless the box is gaged and the wedge as well, it is not necessary to gage the brass. Now the gages will not gage the brass within 1-16 in., to say nothing of the box. The lugs on the box may be out of place and result in the ends of the box being broken out by the longitudinal play of the axle. I think that is occurring and I think some provision should be made against it. I think the gages for the brass should be gone over and made more complete and the gage for the wedge perhaps made more complete and a gage for the box provided.

Mr. W. H. Marshall (Lake Shore & Michigan Southern)—The design shown in the report is exactly interchangeable with all of the boxes, keys and brasses that are used on the 100,000-lb. cars now running. I do not think there are any exceptions that are worth mentioning. We checked it up with the box we have on our road; we have 500 of these cars and there is only one dimension that varies from ours and that was only 1-16 in. and it did not interfere with the interchangeability, and I think that is the situation on all cars. As far as the gages are concerned, I think Mr. Garstang will agree with me that the gages have been made in exact line with gages adopted for other size boxes. There has been no attempt to enlarge on what has been satisfactory for other sizes, but the same standard has been carried to these larger boxes for the gages and keys and brasses.

Mr. Wm. Forsyth—I agree with Mr. Whyte. It is important to have gages for the box of all capacities and additional gages for the wedges and I move that that subject be referred to the Committee on Subjects. Carried.

STANDARD CENTER PLATES.

Mr. S. P. Bush—I am sorry some specific recommendation could not be made by the Committee, even though there was not a great variety of information. Some specific recommendation is desired. I believe that the suggestion made by Mr. Johnson to let the center plate and side bearing be considered in conjunction would be a good idea.

SIDE BEARINGS.

Mr. B. Haskell.—I move that this report be referred back to the committee with instructions to report further on frictionless side bearings. We have some cars that have been equipped with roller bearings for three years and I can find no indication of flattening.

Secretary Taylor then read the following letter from Mr. H. M. Pflager, a member of the Committee:

I wish to congratulate you on the excellent report which you have written and the tests which you have made, and thoroughly agree with you, except with that portion of your report mentioned on the latter part of pages 8 and 9.

I cannot agree with your statements that the rollers which enter into the anti-friction side bearings soon become flattened in service. There is no doubt but that the old style single roller which was used on freight cars a number of years ago did flatten in service, but there are two side bearings made with a number of small rollers now in the market, in which, as far as I am able to learn, the rollers have never flattened in service. Our company has about 2,000 cars equipped with these bearings, some of which have run three years with no flattening, and I have seen roller side bearings removed from under freight cars that have been in service for four or five years with the roller perfectly round.

Your test has shown that a roller side bearing is good if not better with a ⅝-in. clearance between the side bearings. We all know that it is impossible to keep clearance between the side bearings even with metal trucks, and it is thought that a roller side bearing of some description is a great advantage to the car, as it will allow it to round curves easier when the load is on the side bearings reducing the wheel wear and pulling load on the locomotive. Another point which is thought well to consider is that as stated in your letter, the load upon the center bearing is excessive, and it is advisable to reduce the load on the center plate, and also to distribute the load on the center plate and side bearings, thus distributing equally the strain on the car. Could it be done without increasing the drag of the car and wheel wear, your test would seem to indicate that this can be done by the application of roller side bearings, and would it not be more economical, even with the plain plate roller, which would flatten in time, to use this and renew it occasionally than to run the car with plain side bearings? It is thought that it would.

In view of the above, I trust you will change that portion of your report on the last half of pages 8 and 9, after which I will be very glad to join you in signing it.

Mr. A. M. Waitt (New York Central & Hudson River)—With regard to there being a difference of opinion among the members of the Committee, it seems to me desirable, as Mr. Haskell suggests, that the report be referred back to the Committee for further consideration and action. In view of the close alliance between the center plates and side bearings, I move that it be referred back to the Committee and that the side bearings be considered in connection with the center plates, the Executive Committee to make such additions to the Committee as may seem wise. Carried.

DRAFT GEAR.

Mr. J. R. Slack (Delaware & Hudson)—I do not know that I have anything to add to the report. The only thing I would recommend is the desirability of some tests to determine the amount of shock, both in pulling and buffing, and the capacity of the springs in pulling. I might add a word or two in regard to the use of the twin springs placed side by side. As is stated in recommendations No. 2 it appears that it is difficult to get a uniform central draft on springs placed side by side on account of the variation in the tempering of the different springs and the liability of getting a side pull on springs placed side by side; whereas with the tandem springs the pull is more apt to be central. Another point brought out in some of the replies was the economy of maintenance of draft gear where the malleable iron draft arms are used bolted to the sills. It appears from the experiences of the roads that have used the malleable draft arms exclusively, that the cost of repairs with that form of draft gear is very small.

Mr. S. P. Bush—I think the Committee ought to be instructed to make such experiments as would throw light on the subject. It is safe to say that 30 per cent. of all cars that go to the repair tracks are there to have repairs made to some part of the draft appliance. It is not an uncommon—in fact, it is one of the most common things in going along a repair track, to see a drawbar missing, or a draft timber gone, in fact, the whole end of the car gone. The capacity of the present draft spring is 19,000 lbs. Very many freight locomotives to-day will give a tractive power of 30,000 lbs., or over, so that the draft springs on the train are always solid when the maximum tractive power of the engine is being exerted. It is certainly clear that the incapacity of the present draft gear is conspicuous. I think there is one form of draft gear the Committee might touch on and that is the friction draft gear which is coming into the market, and as long as the Committee is going to touch on other types, we ought to make some investigation of that.

Mr. J. R. Slack—I would say that that subject was taken up with the Westinghouse people. I wrote to them requesting some information in regard to it, saying I understood they had made some tests. They replied they had, and would be glad to take the subject up with our Committee; but I did not hear from them subsequently. Owing to lack of time, the Committee itself was not able to do any work on the matter.

Mr. G. W. Rhodes—This Committee is pretty nearly in shape to know what kind of draft appliances ought to be further investigated. If it will get some of the members of this Association to aid in its experiments with a half dozen or a dozen of the appliances that seem to be most worthy of investigation, then when it presents its next report, those members of the Association representing railroads that have had experience with the draft appliances will contribute largely toward giving the Committee their support. Our road would be glad to assist the Committee.

Mr. F. A. Delano—If some of the members would equip locomotive tenders with the various draft gears they would get data much sooner, and more reliably, than by equipping cars, especially with heavy switching engines and heavy freight and passenger engines, on account of the large mileage made and the records which are kept. In this way it would be possible to get the data earlier than by equipping cars.

A motion to refer the question of making tests as outlined by the Committee to the Executive Committee was adopted.

COUPLERS.

Mr. W. S. Morris (Chesapeake & Ohio)—The Committee desires some action to be taken by the Association in regard to the acceptance of couplers to be tested; instructions as to how we shall receive the couplers officially for tests.

Mr. S. P. Bush—I would suggest, for the consideration of the Committee another year, that inasmuch as it has recommended the labeling of the shank, some similar plan might be devised for the knuckle itself.

Mr. A. M. Waitt—I move that the Committee be instructed to address a circular to the different railroads, members of the Association, announcing that a coupler test will be made at a certain time and the roads represented in the Association be invited to send couplers to be tested; and only such couplers shall be tested by the Committee; and that the testing shall be done at the expense of the M. C. B. Association. Carried.

HONORARY MEMBERS.

In accordance with the suggestion of the Executive Committee the following-named gentlemen were elected to life membership in the association: R. C. Blackall, Benjamin Welch, Robert Miller, F. O. Bray, M. C. Andrews, James Denver, G. W. Demarest, H. A. Webster, M. N. Forney, William McWood, Joseph Townsend.

TOPICAL DISCUSSION.

To what extent is it desirable to equip cars with terminal check chains, now shown under the recommended practice of the Association?

Mr. R. P. C. Sanderson, not being present, he sent the following:

There being no question as to the propriety and necessity for chaining cars together when handling double loads, the question then arises what is the best and cheapest way to do it. Flat and drop-end long gondola cars are the only cars that need be considered. Assuming a given railroad to have 600 flats, and say 1,000 drop-end gondolas, if we equip these cars with fixed permanent safety chains, we have put on 6,400 chains on these cars. True, they are short if made like drawing C, M. C. B. recommended practice. A road of the equipment mentioned would hardly handle more than 80 to 100 double loads in any one month, so that, if the chains are returned promptly, 100 long chains would do the same business. Of course, there is the trouble of billing, handling and now and then tracing up the lost chains. The safety chains as shown on sheet C have a certain amount of slack which is quite objectionable, and if coupled up as shown on sheet C must have slack to allow for curving. Properly speaking, if end sill chains are to be used they should be arranged to cross over the drawbars, and be made so short that the drawbar springs must be fully compressed before they can be coupled, then the cars should be pulled apart until the chains are taut, and the couplers blocked out securely. An alternative plan which suggests itself is to have a strong iron strap or eye well secured to the body bolster at the center, and chain the cars together by running chains having a long screw buckle or slip links through these eyes. This again brings us back to the old trouble attendant upon the loose chain and its tendency to get lost. Permanent end sill chains arranged to cross and couple as before mentioned will certainly be the most satisfactory arrangement, but unless everybody's cars are so equipped, or unless we are privileged to put on such standard chains at the owner's cost when needed, very little benefit would be gained from the application of them and the cost to the railroad companies will be much higher than the present troublesome makeshift arrangement.

Mr. G. W. West (New York, Ontario & Western)—I think this will give us more trouble in interchange than all the rest of the trouble we have with the Rules. On some roads the transportation department handles the matter of chains and on others the superintendents. I think ever flat car and every gondola car ought to have permanent check chains.

Mr. W. P. Appleyard—There is a Committee on Dead Blocks and Safety Chains. I think the instructions to that Committee contain the question whether it is advisable to use the safety chain as well as dead blocks.

Should not a standard wrecking chain be adopted, which can be interchanged between roads with cars, without necessitating removal?

Mr. A. M. Waitt—The subject of standard wrecking chains seems to me to be worthy of some consideration. We all know with interchange cars loaded with long timber it is necessary to have some chain connection between the two to prevent disastrous results of there should be a break-in-two; and it is the practice with a good many roads to allow chains to go through, and after the car passes trace the chains through the freight billing and eventually get them back. On some roads it is the practice to exchange chains. Other roads prefer to retain their chains on their own road and not allow them to go on other lines; and probably getting back a ⅝-in. for a ⅞, or ¾ for a ⅞-in. chain. It would be desirable if something could be adopted as an M. C. B. standard for chains, specifying size and length, so the necessity for restricting the movement of chains could be done away with and save the wasted labor of road A removing theirs, and road B putting them on. I think if we do not have too many subjects next year to select from, it is worthy of consideration by a Committee.

Mr. F. A. Delano (Chicago, Burlington & Quincy)—Some three years ago the General Superintendent of the road with which I am connected issued an order that the use of chains on cars handled over our own road be dispensed with; that is, chains between the flat cars or open cars loaded with long material or bridge iron. To some

(*Continued on page 454.*)

RAILROAD GAZETTE

ESTABLISHED IN APRIL, 1856
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EDITORIAL ANNOUNCEMENTS

CONTRIBUTIONS—Subscribers and others will materially assist us in making our news accurate and complete if they will send us early information of events which take place under their observation, such as changes in railroad officers, organizations and changes of companies in their management, particulars as to the business of the letting, progress and completion of contracts for new works or important improvements of old ones, experiments in the construction of roads and machinery and railroads, and suggestions as to its improvement. Discussion of subjects pertaining to ALL DEPARTMENTS *of railroad business by men practically acquainted with them are especially desired. Officers will oblige us by forwarding early copies of notices of meetings, elections, appointments, and especially annual reports, some notice of all of which will be published.*

ADVERTISEMENTS—We wish it distinctly understood that we will entertain no proposition to publish anything in this journal for pay, EXCEPT IN THE ADVERTISING COLUMNS. *We give in our editorial columns* OUR OWN *opinions, and these only, and in our news columns present only such matter as we consider interesting and important to our readers. Those who wish to recommend their inventions, machinery, supplies, financial schemes, etc., to our readers, can do so fully in our advertising columns, but it is useless to ask us to recommend them editorially either for money or in consideration of advertising patronage.*

Nobody can doubt the success of the mechanical conventions this year as regards attendance, enjoyment and the interest of the display of apparatus and materials which has come to be a feature of these conventions, and which gives them something the air of an important fair. No doubt Saratoga is the most comfortable place in America for holding these conventions. It is not always cool there, but it is pretty sure to be cooler than more southerly points, even on the seashore, while the vast hotel accommodations are more than sufficient for any number of people that the conventions can bring together. Those who have attended recent conventions at other places will appreciate the importance of this point. Two or three years ago we mentioned a suggestion made to us by an officer of the Master Mechanics' Association to the effect that the two associations should establish at Saratoga a permanent hall and a permanent display of such things as the supply houses are in the habit of showing at the conventions. Indeed, that gentleman's suggestion was that Saratoga be made the permanent headquarters of the associations. Of course there are some obvious objections to these plans which we need not discuss now, but we are told that the citizens of Saratoga stand ready to build a hall for the associations on the condition that some agreed percentage of the conventions be held at that place. It might be worth while to look into this matter seriously.

The most prominent railroad news in the daily newspapers for the last week or two has been that concerning the alleged formation of pools. To most of the newsgatherers this seems to be a very fascinating subject. They seem to have "caught on" to the fact that a participant in a pool is more or less of a lawbreaker, and they naturally assume, therefore, that when railroad officers refuse to tell what they have been conferring about in their meetings, there must be something in the fact of secrecy that will be particularly interesting to newspaper readers. As a matter of fact there is no ground whatever for the reports that have been published, except the gossipmongers' assertion that the presidents of the roads west of Chicago, at their meeting in Chicago (adjourned from New York) would try to do something to put a stop to the demoralization in rates, particularly in packinghouse products from Kansas City. The presidents met, and they completed the establishment of local committees, as reported in our issue of June 15, and in the Traffic Notes to-day; but beyond that it appears that they did nothing more than or different from what has been done at the conferences which were attended by Mr. Knapp; that is, every one promised to adhere to published rates. A conservative New York paper, in a column article aiming to show that pools are being maintained, makes out to muster just one opinion—not a fact—to substantiate its headline, to-wit, that a railroad officer in New York opines that packinghouse products out of Kansas City have for some time apparently been judiciously routed to the satisfaction of all the railroads, and also of the shippers.

Even so innocuous a proceeding as "judicious routing" may be repugnant to the anti-trust law; as it implies a conference between roads, and a conference, under that law, is prima facie wicked. (Friendly diversion of traffic is not, in our opinion, an offense against the anti-pooling law). But in view of the utter failure of all attempts of this kind heretofore it does not seem likely that the Interstate Commission could find anything illegal in the doings of these roads at present. Apparently the worst thing that these presidents have done is to maintain unnecessary secrecy. A Western paper says: "It is surprising that in such a gathering of intelligent men at this late day there could be found any advocates of a policy of secrecy as to the purpose and scope of the co-operative movement, or the basis of the plan proposed as a remedy for the rate-cutting evil. Managers invite hostile legislation and incur the enmity of shippers by just such tactics. An agreement that will not bear the light of day can have but a brief existence in any section of the country. The attempt to cover up the work accomplished in Chicago is possibly the greatest blunder yet committed by the executive officers." As at least a very large majority of the participants in these conferences are determined to have everything above board, it would appear that in assenting to secrecy these gentlemen are sacrificing their own interests to satisfy a very small minority who are acting with very poor judgment. The real ground for hope from these conferences lies in the measures taken to have all rate changes laid directly before the executive officers. The recognition of this principle was what gave strength to the Joint Traffic Association; and the toleration of too many links in the chain between the president and the local freight solicitor is what has made most of the trouble in innumerable rate-wars.

The Master Mechanics' Reports.

Last week we summarized the reports of the Master Car Builders' Association and now do the same for the Master Mechanics' reports at the Saratoga meeting. Some of these are particularly fine papers and will make this year's proceedings a useful volume for reference.

The first report, in order, was that concerning the extent to which the recommendations of the Association have been put in practice. The committee was unable to get enough information about the practice of different roads to draw definite conclusions, but it was apparent that by no means were the recommendations of the Association being disregarded. As a result of the committee's work, however, there is now available a very complete alphabetical and classified index of all the subjects dealt with in the reports and papers and discussions since the beginning of the Association. Those who have frequent occasion to consult the volumes of Proceedings will best appreciate what this means.

A number of reports require but brief mention. Thus the committee on cast-iron and steel-tired wheels failed to gather any information not covered by its report last year and the report really forms no basis for discussion. The report on the best type of stationary boilers for shop purposes is exceedingly elementary, and we would recommend those interested to read the excellent paper by Mr. F. W. Dean, published in the *Railroad Gazette* of June 15. This paper contains much information which the committee recommends should be got by experiments and incidentally it shows that such tests would simply duplicate work already done.

The report on flanged tires for locomotives is interesting and should bring out discussion on account of the broad conclusion that it is desirable to have flanged tires on all the driving wheels of mogul, ten-wheel and consolidation engines. The tests upon which this conclusion is based, were hardly sufficient in themselves to warrant such a broad statement, and no doubt the experience and opinions of the committee had an important influence on the form of the report.

The piston valve report is brief but in general is favorable to that type of valve; it being considered best suited for steam pressures over 185 lbs., as the friction is less and the question of lubrication is very much simplified. The cost of maintaining piston valves is thought to be more than for plain slide valves, but in the former type the admission and exhaust ports can be materially increased, which is an advantage. Piston valves having internal admission are preferred, but when these are used the valve gear must be modified to suit. Plain snap packing rings are said to give perfect satisfaction.

The report on journal bearings, cylinder metals and lubrication is made up of answers to a circular letter, and while it contains a good deal of information, it is hard to read. A summary has been published in another place and it is enough to say that the committee was unable to make any recommendations as to the best iron mixtures for cylinders and such parts. The practice of casting locomotive cylinders separate from the saddles is not approved. Much difference of opinion is shown by the report as to the composition of locomotive bearing metals; also in the design of driving boxes and in the location of oil holes no uniformity is shown. The modern lubricator when properly applied is considered satisfactory.

The remaining reports have been prepared with unusual care. The committee to suggest ways in which the Association can increase its usefulness makes seventeen suggestions, some of which merely involve small changes in the ways of conducting meetings while some of the more important are the printing of a complete index of the Proceedings from the first volume to date, the establishment of a library similar to that of the Western Railway Club, providing for the reception of individual papers, the appointment of standing committees on subjects of motive power progress and an effort to make the committee reports thoroughly reliable. The report is well prepared and is bound to have a good effect on the future work of the Association.

The committee on the ton-mile as a basis for motive power statistics makes an able argument, and the chief conclusions may be mentioned. It is held that statistics for the motive power department should include the weight of the entire train and those for the operating department should include the weight of train between the tender and way car, two sets, if need be, being kept. For motive power statistics, all items of cost of engine service should be on the ton-mile basis and the statistics of all classes of service should be on the same basis. It is desirable to group the individual fuel statement and oil statement, each service by itself; the statistics of main line and branches should be separate; the ton-mileage of mixed trains, part passenger and part freight cars, should be credited to that service which is entitled to the greater proportion and the tonnage of a locomotive should be its weight in working order plus that of the tender with half its capacity of coal and water.

The compound locomotive report is very complete in showing the present status of that kind of locomotives. From this report one can learn what are the advantages and disadvantages of compounding locomotive cylinders, the kinds of compound locomotives tried up to the present time and a brief history of their development. Then there are illustrated and described all the types of compounds now commonly used in this country, a number of important letters are reproduced, and a very complete list of references to the literature of compound locomotives is given. Finally the conclusions of the committee are embodied in thirty-one concise statements. From these it is gathered that the compound locomotive is emerging from the experimental stage and there is a growing tendency to use compounds for fast, heavy passenger service as well as freight. On a ton-mile basis the average fuel saving of the compound is about 16 per cent., and it can be pooled the same as simple engines. It is also held that no difference should be made in the ratings of simple and compound locomotives of the same class; manual control of the compounding feature is preferable to automatic control; boiler repairs of compounds average about 20 per cent. less than simple engines; the cost of maintenance of the machinery is a little more for the compounds and about 15 per cent. more oil is used by them. Modern compounds are holding their place with simple engines, and it is not thought advisable to change any of the older compounds into simple engines. All of these conclusions should be read in the light of the discussion at the convention. Indeed, some of them were materially modified there.

The report on power transmission by shafting and electricity is full of information needed just now, and anyone contemplating shop improvements should study it. It is published elsewhere at considerable length. For the busy man the principal conclusions only will be given here, namely: "In a small shop, consisting of one building, having an equipment of small tools for light work only, electric transmission will not be found a paying investment. In such a shop, however, an electric lighting dynamo will be a convenience, and may be used to run a few labor saving electric tools. In an extensive railroad shop plant, the installation of a central power station and electric transmission will always be found advisable as it will not only result in the most economical

system in respect to operation, but will make possible far more important shop economies, namely, an increase in quantity and quality of output and a reduction in the cost of handling materials."

Locomotive Draft and Exhaust.

In the *Railroad Gazette*, January 19, page 32, May 25, page 332, and in this issue may be read parts of valuable reports of Messrs. Sauvage and Quereau on Exhaust and Draft Appliances for Locomotives, as made to the International Railroad Congress. The conclusions reached by these reports have been reprinted by us in full, and now some further discussion may not be without interest as expressing actual experience or reasonable inference.

A significant paragraph in the summary of Mr. Quereau's report is that in which it is said in sense that the degree of vacuum obtained is not the true measure of efficiency; that draft is secured at the cost of back pressure. Investigation by superintendents of motive power, and (even closer to direct contact with engines) by master mechanics, will, in many places reveal a condition unsuspected in sizes of exhaust nozzles. Good steamers, so-called, are running, by the score, with exhaust exits that are restricted to the point of asthma. Nozzle tips are bushed or bridged, or both, to an extent not generally known. An engine is often very different in operation from what it was designed and sent out to be, and sometimes there is not courage enough at the division master mechanic's office to report back to the superintendent of motive power the lack of draft; the bushing and bridging is then surreptitiously done. Sometimes even the master mechanic does not share in the secret, and matters are arranged between engineers and roundhouse men. This is probably one of the chief reasons why front-end questions have remained so clouded with doubt while definite conclusions have been reached on many other questions as complex.

The statement that correct rules for most efficient stack proportion are still a matter of doubt is true, but it is only conditionally true that a bridge in the exhaust tip lessens the efficiency of the exhaust jet. There are conditions under which a small nozzle bridge will save an engine failure and get the engine home for help. It is thus possible to fill a large stack, or draft a leaking front end or firebox, but then only is it justifiable. A split or bridge will effect noticeable economy in coal on an engine that is over-supplied with smokestack, which assertion has been proved by scale weights. Stacks on American locomotives are too large in diameter oftener than too small, and this error is not uncommon. It is costing much to support theories of stack dimensions where those dimensions preclude the possibility of good steaming with economical cylinder action.

Again, a front end design that sets up a cumbersome or complicated exhaust nozzle, flanks it closely at base and sides with large and heavy steam pipes, obstructs the flue exits with other devices, and shed-roofs the greater part of this apparatus with a diaphragm having abrupt angles in the path of the natural draft, is wrong in principle and proves that fact daily in practice. Yet this description will be recognized by many readers. Obstruction to an air current should be treated even more carefully than obstruction to a flow of water. Air, being highly resilient, works a greatly multiplied confusion when abruptly diverted from direct passage. Probably there is strength in the assertion that it may be possible to discard the diaphragm and to adjust draft with sheath pipes entirely. The exhaust pipe should be as direct and simple as possible. In many front ends a thorough housecleaning is needed, with the permanent removal of much of the furniture.

The variable exhaust nozzle will never win in the court of last resort, the expense account in the motive power department, while nature and man remain what they are. There are too many variables in the operation of these devices. Chief of these is the unwarrantable demand made upon enginemen and master mechanics for maintenance and operation of the nozzle. Viewed from the standpoint of power production, it is a spendthrift adjunct to the power plant entrusted to a busy, possibly overworked, engineer and fireman. If made automatic with the movement of the reverse lever, there are phases of load and speed conditions that the variable exhaust nozzle, thus operated, will not meet.

We fully admit the tender conscience and the nice sense of honor of the average engineman; but we have seen him in this situation—the engine in distress, stalled in a winter gale, his guiding ambition was to stand on the jacket, to keep a flaring torch lighted, to avoid a scorching at the stack, and lower a six-foot pinch-bar down the stack and into a four-and-seven-eighths inch nozzle tip. Obviously it was a most satisfying moment when the bar was safely lodged. And yet a bridge in a nozzle tip is ordinarily unnecessary and injurious when the stack and nozzle are properly made. We infer from such an experience that men as they go would, unhesitatingly, choke an adjustable nozzle down to the point at which a fierce blast would result, regardless of cylinder conditions, at the first lack of steam. The report of M. Sauvage plainly states the experience of one railroad, which is probably the story of them all if it were told. That is, with a variable exhaust device it was found that the nozzle had become permanently set from disuse. Experience leads to the inference that engineers would not set the device where it caused them any lack of steam; that the orifice would be made small rather than large, and that they would have little concern about loss from back pressure as long as the immediate purpose of raising the steam was served.

In determining the length of front end, it should be regarded as filling the double office of vacuum room and destruction chamber for sparks, but not as a place for their retention. Once sufficient space is allowed for netting, the shorter the front end is made the more direct is the action of the exhaust on the fire, the larger the exhaust tip that will suffice, and the less the back pressure caused. The theory that the same amount of air will be drawn through the fire regardless of the cubic contents of the chamber through which the exhaust jet passes will not hold in practice. This principle we have seen demonstrated in road work. The lengthening of a smoke arch by one-third of its normal length will, without other change, reduce a clear white fire to a red, sooty glow, fill a front end with cinders and destroy the steaming qualities of the engine as a whole. The use of a partition for the purpose demonstrates that air in this capacity must be treated as a highly elastic medium, having great atomic coherence, rather than as an infinity of inert particles that may readily be singly entrained and closely retained by the exhaust jet until ejected from the stack. There is a decided inclination of the enclosed air-body to remain intact, and this effect is heightened by the intermittent rush of air down the stack between periods of exhaust. This is particularly true when engines are being urged to their utmost at long cut-off and slow speed.

Mr. Quereau gives the key to many vexatious and expensive situations, in that paragraph in which he asserts that condemnation for good draft apparatus often comes through unskilled work in firing, and thus confuses the true result.

Entirely too much liberty has been allowed the roundhouse and the shop in front-end adjustment, and the front-end as a distinct factor in engine operation is still nobody's child. Even in the light of these considerations, however, we are inclined to accord more weight than does Mr. Quereau to the assertion that a draft device proved satisfactory with one kind of coal and in a given place may be entirely unsatisfactory elsewhere and with another coal. A type of engine, transferred, goes with its grate and flue area unchanged. As a rule they are the fixed quantities. The altitude of the road and the chemical composition of coal are widely changing factors that have their effect in volumes of gases supplied and liberated.

The report of M. Sauvage is of interest to locomotive builders in the United States more because of the comprehensive trial of detail recorded than because of fitness of the parts for use in American operation. Many of these conceptions are illustrated in this issue. The dampered stack, the vortex nozzle, and the variable nozzle tip are not enticing. There are, for example, portions of the United States in which a front end netting too closely meshed and consequently clogged, will cause gas explosion in the firebox that will result in the injury or hasty desertion of the engine crew, under the impression that the crown sheet is down. Obviously, the dampered stack would not thrive in those places. The annular vortex nozzle clogs, is difficult to maintain, and, seemingly, is of doubtful merit at best. It is impossible to adapt it to general use here.

In the matter of heating feedwater for locomotives nothing new develops from the reports.

The lines of progress in front-end work seem to run toward reduction of length of front end; study of possible discarding of the present diaphragm or greatly modifying it; reduction of the bulk of steam pipes and exhaust pipes; increase of size of nozzle tips and decrease of stack diameter; and, finally, a rigid adherence to that which is good and the raising of the front-end devices to a dignity and care which shall equal that bestowed upon valves, pistons or any other vital part in engine equipment. We would classify bushing and bridging exhaust nozzle tips; raising or lowering, lengthening or shortening, diaphragm plates; changing the height of exhaust pipes; and changing the set of valves or the working pressure of boilers, without due authority for experiment, all in the same category of offenses against good railroad government.

Taken all in all, there is good ground for belief that a reconsideration of the front end in its evolution as a most important part of the unparalleled growth of locomotives during the past two years, might profitably occupy the attention of the Master Mechanics' Association. Before the conclusions of the association can be brought to their most valuable form, it will be necessary to make further careful experiments upon testing plants that are suited to the work; to follow this with application to road service; to use great care in obtaining facts, and, having done these things, to tell the truth with as little prejudice as is possible to weak humanity.

New Railroad Building for Six Months of 1900.

The new railroad built in the United States during the first six months of 1900 was approximately 2,025 miles, divided among 190 lines. This is the preliminary estimate of the *Railroad Gazette* from letters and telegrams received from a large number of the railroad companies. Later returns will no doubt slightly change these figures. During the corresponding period last year the mileage completed was only 1,181, which was less by nearly 850 miles. Yet the record for the entire year was 4,569 miles, the highest figures of railroad building since 1892. Only 26 per cent. of the roads built last year were completed during the first six months. At the same ratio the new mileage for the entire twelve months of 1900 will exceed 7,500. But last year's ratio for the first half year was unusually small. The usual percentage is from 33 to 40 of the year's building, which would make the probable figures for the entire year 1900 from 5,000 to 6,000 miles. This estimate at best, however, is but guess work.

In the new building for the six months of this year Texas leads with 164 miles. Then follow Iowa, with 150 miles; Mississippi, 119; Georgia, 117; California, 104; Pennsylvania, 103; South Carolina, 102; Oklahoma, 78; Minnesota, 77, and Arkansas, 62 miles. The heaviest building has been in the South and West. Among the individual companies the Chicago & North-western leads with 156 miles; the Southern Pacific has 97 miles; the Chicago, Burlington & Quincy, 96, and the Seaboard Air Line, 95 miles. The Gulf & Ship Island has built 72 miles; the Chicago, Rock Island & Pacific, 57; the Atchison, Topeka & Santa Fe, 54, and the Northern Pacific, 52 miles. The mileage of the Atchison and of the Seaboard Air Line is particularly noteworthy as filling in important links in through lines, one to the Pacific coast and the other into the South. With the single exception of the Gulf & Ship Island, the only considerable building of the six months has been done by the older and larger companies. The present tendency of new building in the East particularly is well represented by the State of Pennsylvania. The 103 miles credited to that state are divided among 27 separate branches and spurs, most of which are by old companies.

In the table by states and territories given below nine are not represented. These omissions include all the New England states except Vermont, also Delaware and the District of Columbia in the East, and New Mexico and Nevada in the West. Of the states represented, Kentucky, New Jersey, New York and Utah have less than five miles each of new road to their credit. The figures by states and companies are as follows:

New Mileage by States.

States.	Lines.	Mileage.	States.	Lines.	Mileage.
Alabama	7	37.25	New Jersey	2	3.5
Arizona	3	36.25	New York	3	5.6
Arkansas	4	62.	North Carolina	4	27.
California	8	104.7	North Dakota	1	26.
Colorado	4	14.75	Ohio	6	29.
Florida	5	55.	Oklahoma	3	78.5
Georgia	8	117.07	Oregon	3	47.5
Idaho	1	23.8	Pennsylvania	27	103.25
Illinois	4	49.9	South Carolina	4	101.86
Indiana	2	34.2	South Dakota	3	59.
Ind. Territory	1	40.	Tennessee	5	53.
Iowa	3	149.87	Texas	14	164.5
Kentucky	2	4.	Utah	2	2.25
Louisiana	4	26.7	Vermont	1	25.2
Maryland	2	7.	Virginia	5	44.4
Michigan	7	34.5	Washington	6	43.1
Minnesota	8	77.06	West Virginia	8	45.75
Mississippi	8	119.5	Wisconsin	2	9.
Missouri	5	28.5	Wyoming	2	52.6
Montana	2	30.5			
Nebraska	1	52.	United States	190	2,025.56

Switzerland has plenty of trouble in connection with its acquisition of the railroads by the State. Although this has been determined upon about a year, the first of the railroads to be transferred will not come into the possession of the State until 1903. It is not even known how much must be paid for the railroads. Some years ago a law was passed providing for a government audit, so that the government might have actual knowledge of the accounts of the roads and not be compelled to depend wholly upon the companies' reports. But the prices fixed by legislation for the roads have been declared by the courts not to be binding on the companies, and the values of the railroads must be fixed according to the contracts made when they were chartered. But the most trouble seems likely to come from the various demands

made on the future State Railroads. The employees have taken time by the forelock and insist on having better pay, shorter hours, more vacations, higher pensions, and an earlier age for retiring on a pension. Then the public clamors for more trains, greater speed, lower fares and freight rates, and other increased accommodations. Meanwhile, since the vote for a State system, money has become dearer, and the State is likely to have to pay ½ to 1 per cent. more interest on the bonds with which it will pay for the railroads. It is a question on which leading lawyers differ whether the bonds of the railroad companies will not fall due when they have transferred all their property to the State. There is a very strong socialistic party in Switzerland, and there, as elsewhere, other people are likely to favor low rates and improved accommodations, without much consideration of the consequences; but they are a hard-headed people, too, and if they have to pay taxes a year or two to meet a deficit on their new State Railroad system they will not be likely to persist in a policy which results in a deficit.

The Master Car Builders' Convention.

(*Continued from page 451.*)

of us that seemed a daring innovation; but I can say it has been remarkably successful. His argument was that the danger of break-in-twos between cars loaded with long material was very much less than between individual cars; that the load lapping over from one car to another, in itself, helped to hold the cars together. This practice has been going on for nearly three years, and I have not heard of a single accident occurring.

Good methods for terminal cleaning of passenger cars, and is it advisable to have oil in the cleaning mixture?

Mr. A. M. Waitt—This topic seems to be one in which there is a good deal of interest and upon which there has been a good deal said and written during the last year. In general there seem to be two kinds of terminal cleaning—the temporary cleaning at the end of the ordinary runs, which is done every day. It consists, in some cases, of washing the car down with a large Turk's head brush and water, and the wiping of the trucks. The latter is done in most cases, I think, by going over them with waste saturated with kerosene oil, and in some cases ordinary car oil, although that is rather expensive. Then the trucks are wiped off in good shape or indifferently; if indifferently, making a good foundation for the trucks to be well painted with mud at the time they get to the end of the next run. Then the inside of the car is generally swept out, and the wood-work dusted once a week, or sometimes oftener in dusty countries, wiping off the lamps and cleaning and trimming them, and in some cases, although unfortunately not always, the saloons, urinals and hoppers are rinsed out and disinfected. That seems to be, I think, the general practice for ordinary terminal cleaning.

On some roads it has been considered inadvisable to wash cars at all except in weather when it is impossible to dry-wipe them. I think a large number of roads during the past few years have abandoned in dry weather the washing of cars on the outside, because it is considered that ordinary water is as injurious to varnish, almost, as anything that can be put on it.

The success with which we have met in dry-wiping cars has been very gratifying. On the road with which I am connected, we have done away with the washing of cars with water at terminals, except during damp weather, when there are cinders on the car which can not be wiped off because the surface is moist. I think the varnish has stood better and the equipment looks better. There are times after three or four months, or it might be after three or four days, if the car goes through a great many tunnels, when you have to treat them in a different way and give them a thorough scrubbing in some manner. Various methods of doing this have been adopted, some of which are satisfactory and some others are not. Some methods are diametrically opposed, and yet they are suited to the respective roads using them.

The question is brought up in the topic as to the advisability of having an oil cleaning mixture. The idea of the introduction of oil in cleaning mixtures as it has been introduced by several roads during the last year, is to put in something which will give a little polish; a little renewal of the life of the varnish. Different kinds of oils are used, and I think it is due to this fact that the difference in results is obtained. If an oil, such as linseed, is used, which, by the action of the sun will dry and leave a skin on the surface of the car, any dirt there may be in the cracks or grooves is impossible to get out until the car is scraped with soap or pumice stone or something of that kind. On many cars it has been noticed, after the surface of the panels is clean, inside of the beads is black and you can not get it out with water and rubbing. It is necessary to take something like pumice stone or soap to start it. Other oils may be used which will not dry with anything like a skin or surface at all. With these oils the difficulty just stated is entirely avoided. It seems to me the consideration as to what oils shall be used in a cleaning compound, is worth looking into.

Mr. G. R. Joughins—Ten years ago I went to a little road in the South and I found they had a system of car cleaning without the use of water; they used waste, dry-cleaning as described by Mr. Waitt. I think I can safely say from my experience there that anyone who tries that system will never use water again.

The only question I had to deal with was how to clean out the dirt which accumulates around the beads and other such work. I can not say that I have successfully solved that; but I am quite certain about the general principle of dry cleaning and express my opinion to that effect.

Mr. Wm. Garstang—I think our Foreman Painters are probably the best posted as to cleaning cars. We have a sister association, the Master Car & Locomotive Painters' Association, and I understand it has asked us on several occasions to name subjects it might be advisable for it to take up and investigate. I move that the Secretary be instructed to write the President or Secretary of the Master Painters' Association, asking if it will not make this one of the subjects for the next convention, and that they be requested to make a specific recommendation on this subject. Carried.

Mr. H. S. Hayward—The cleaning of the exterior of passenger cars is a problem to be worked out by each road separately, owing to the physical character of the roads. Some roads use dark colors which do not show the dirt like light colors. Many roads use anthracite coal on passenger trains and that makes a difference; also the number of tunnels they pass through. We could hardly lay down rules to govern all the lines.

Mr. H. M. Pflager (Pullman Co.)—We run cars in all parts of the country and clean them by dry wiping and also by using water, and we find there is very little difference in the appearance of the car after twelve months as to which method is used. In some cases the dry wiping seems to be best, but in other cases the washing serves best; and on the whole it seems to make very little difference. On roads that have a number of tunnels a little sandpapering is necessary.

Mr. W. S. Morris—We have light-colored cars, and use a cleaner composed of a certain oil. We use a sufficient quantity of evaporating oil combined with the linseed oil that will neutralize the alkali in whatever amount of soap we determine is necessary to use in the composition. About once a week we have to use this cleaner on our light colors. When we ran the Pullman cars with a dark color we found we could use the dry system considerably longer without introducing the liquid cleaner. We have a great many tunnels and burn bituminous coal, but it is a smokeless coal. There is an accumulation gathers on the light color that has to be removed by some liquid cleaner; the dry cleaning will not work. None of the gentlemen seem to know what their system of cleaning costs and that is important. I would say that our cleaning costs us about 30 cents a thousand miles for all cleaning, inside and out.

Is a charge against the car owner for repairs on account of truing up tapered journals correct and proper?

Mr. G. W. Rhodes—I think to get at that question one must consider that there are two sides to it. One side is unfavorable to charging it to the car owner and the other side is favorable to charging it to the car owner; and when these questions come before the M. C. B. Association, they must be worked out on a system of averages. The car owner will claim that when his car leaves his possession it is in the hands of the road that is handling it, that that road has an opportunity of inspecting the box and the journal and of accepting it or not, and that the fact it accepts it ought to be proof that the journal is in good condition and that a great deal will depend on the care the journal receives at the hands of the road that is handling it. If this road does not give it the proper attention in the way of oil or waste, that the journal is apt to be damaged and that the owner is not responsible for it, but the party having the car in his possession is responsible. The same thing applies to the bearings and that the railroad has the privilege of removing the bearings when they are worn out or not wearing properly. That if a road having a car in its possession neglects to attend to these bearings, it should be the one to suffer and not the owner of the car.

On the other hand the arguments for the other side would be that owners use their own designs, their own style of brasses and their own kind of material, all of which affects the wear of the journal. In a good many cases that the journal boxes are not properly kept up; they are allowed to wear out and get out of shape and go to the home shop of the owning road, and they do not attend to the journal boxes but let them go out again in this improper condition which will affect the wear of the journal. I think it is safe to say that many cars go into the owner's home shop where they utterly disregard the question of dust guards, and they will turn the cars out so that you can open the box lid and look through to the wheel, and if dust comes in at the rear end and wears the journal, it would seem that the parties arguing that the owner is responsible, would have a good ground for it. Then again, as the trucks go to the shop the matter of keeping the trucks square is one that gets little attention and those holding the owner responsible use that as an argument.

Summing up the thing, my own individual view is that there are too many arguments in favor of the party having the foreign trucks in its possession, charging the owner for tapered journals; and I am a strong advocate of charging such work to the owner of the car.

While on this question, I wish to impress upon the members that we are not giving car equipment the attention it ought to have in its running gear. The condition of the trucks is far from what it ought to be. The principal thing which changes the conditions is the speeds at which we are moving the equipment. I have ridden a great deal of late on freight trains and have been surprised at the speed. In a conversation with a locomotive builder not long ago as to what forms of equipment were safest to use, I was much interested in the cool way in which he spoke of the high speeds of our passenger trains. He mentioned a certain form of construction which was all right for speeds of 60 miles an hour, but for speeds of 70, 80 and 90 miles an hour, he said that more attention had to be given to what constituted safety. One of our men on a freight train recently observed the speed, knowing that on our road 28 telegraph poles constituted a mile, and if he passed 28 telegraph poles in a minute the freight train was going at 60 miles an hour. He passed 35. (75 miles an hour.) Since then he has frequently reported 28 telegraph poles to the minute.

There was no discussion of the report on "Air-Brake Appliances," the idea being that the suggestions made in the report would be considered by the Executive Committee in appointing committees for next year; the present Committee being discharged. For lack of time, the chairmen of the committees on "Recommended Practice for Springs for 100,000-lb. Cars" and "Uniform Section of Siding and Flooring" were unable to prepare reports and an extension of time was granted. The same action was taken in the case of the committee on "Metal Dead Blocks and Safety Chains," where the members of the Committee could not agree on a report.

ELECTION OF OFFICERS.

On motion the Secretary was authorized to cast the ballot of the Association for the following officers for the ensuing year: President, J. T. Chamberlain, Boston & Maine; First Vice-President, J. J. Hennessey, Chicago, Milwaukee & St. Paul; Second Vice-President, J. W. Marden, Fitchburg R. R.; Third Vice-President, F. W. Brazier, New York Central & Hudson River; Executive Committee: E. D. Bronner, Michigan Central; J. H. McConnell, Union Pacific; and William Apps, Canadian Pacific; Treasurer, John Kirby, Lake Shore & Michigan Southern.

Car Service Managers' Meeting.

The National Association of Car Service Managers held its annual meeting at Atlantic City, N. J., June 18 and 19.

A number of interesting papers were read by members touching upon various phases of association work. A valuable contribution to the car service question was a paper entitled "The Relation of Car Service Rules to the Traffic Department," prepared by Mr. H. F. Smith, Traffic Manager of the Nashville, Chattanooga & St. Louis, which was read by Mr. Haskell, Manager of the Southeastern Car Service Association. The convention ordered this paper published in pamphlet form for general distribution to railroad officers. We may briefly summarize it by saying that it set forth the business argument for demurrage. The operating departments of railroads, including roadway, machinery and movement, create a commodity known as transportation. The province of the traffic department was to sell it. In order to intelligibly fix the price it is necessary to take into account the various items of cost entailed in producing. One of these important items to be taken into account is car service. It was maintained that this should be applied to all classes of freight, and that a varying time limit should be adopted, suitable to the length of time necessary for unloading the various commodities. As a great many classes of freight can be unloaded within a few hours, their time should be fixed accordingly, instead of having a maximum allowance, as at present, for all kinds of traffic. Mr. Smith held that car detention was an important factor in the cost of transportation, and that car service rules should therefore be applied uniformly at all stations, with a proper classification based on the time required by the various classes of freight.

The special committee on the application of car service rules to export freight (not on through consignments) reported progress, and was continued.

There were at this convention interesting and profitable discussions on the practice of the various associations, which may be summarized as follows:

1. "Charging for detention when connections will not receive." The consensus of opinion was that when the delivering road would not receive cars because of consignee not being able or ready to handle them, the road holding such cars should charge for detention, and let the charges follow the goods.

2. "Associations' Reports to Railroad Auditors. On this subject a diversity of practice was discovered, some auditors requiring that the association report the earnings of stations in detail, others only requiring report of totals.

3. "Storage in connection with Car Service." Mr. Albright, of the North Carolina Association, explained the operation of storage rules in his territory covering freight in railroad warehouses, which he said gave great satisfaction, and resulted in keeping the depots clear. Mr. Berry, of the Columbus Association, explained the rules in force in his territory, under which package freight was sent to public warehouse. This custom operates to the great relief of the railroads in keeping their premises clear. Mr. Morse, of the New York and New Jersey Association, stated that his Executive Committee had compiled a classification, approved by the Trunk Line Classification Committee, showing just what articles are susceptible of storage and what are not, which will be of great value in settling this mooted question.

4. "Refund of Car Service Charges Caused by Errors of Other Roads." This subject was again up for discussion, brought out by a paper by Mr. Prall, of St. Louis,

in reply to a paper on the subject by Mr. Haskell, page 44, 1899 Proceedings. Mr. Haskell presented a request from his association (Southeastern) that this association take up the subject with the Car Service Committee of the American Railway Association for decision. A motion to this effect was carried, and a committee appointed. This question presents the strange anomaly that while five-sixths of the associations are opposed to refunding, a small majority of the managers are in favor of it.

It was the sense of the association that, as a principle of equity, the belt lines and small roads, when not members of car service associations, should be charged with cars direct under car service rules, the same as individuals, with reasonable additional time allowance for movement.

The election of officers resulted as follows: President, J. C. Haskell, Southeastern Association, Atlanta, Ga.; Vice-President, J. C. Loomis, Louisville, Ky.; Secretary-Treasurer, A. G. Thomason, Scranton, Pa. The association voted to hold its next annual meeting in Denver, Colo., in June, 1901.

Train Dispatchers' Annual Meeting.

The thirteenth annual convention of the Train Dispatchers' Association of America met at Atlanta, Ga., on June 12. Addresses of welcome were made by Governor Candler for the state, and by Judge William A. Anderson for the city. The President in his annual address congratulated the association upon the large and healthy growth of membership and income during the past year. The association is nearly out of debt. In view of the publication of names of applicants in the official organ, he recommended that applications for membership be accepted if indorsed by one member or by the Chief Dispatcher or Superintendent under whom the applicant worked. The Executive Committee submitted a proposition from a Toledo publishing house to assume the business management of the official organ on favorable terms, acceptance of which was recommended. The report of the Train Rules Committee discussed briefly several questions brought up in the official organ during the year and considered worthy of attention, including those of "Superior Extras," "Absolute Meeting Points by Time Table" and "Printed Forms for Train Order Records."

Two sessions were held on Wednesday, all of which were devoted to the reading and discussion of papers. These were on "Superior Extras vs. Scheduled Trains" and "Positive Meeting Points by Time Table," by Secretary Mackie, and "Special Train Schedules," "Train Order Signals," and "Meeting Points for Same Class Trains," by J. W. James, of the Wisconsin Central, Fond du Lac, Wis. The first of these suggested the running of all freight trains on schedule in one (the superior) direction, and as extras in the opposite direction, with a view to simplifying the question of opposing rights and thereby securing greater safety. The second advocated the absolute meeting point by time table rule in the case of passenger trains and, possibly, of preference freights, which could be depended upon to be on time, or nearly so, every day. The papers of Mr. James were mere sketches upon the subject treated, but brought forth considerable discussion. All were ordered printed in the proceedings.

There was but one session on Thursday. The matter of separate business management of the official organ was referred to the new Executive Committee with power to act. Certain suggestions of the secretary regarding more perfect organization were strongly approved and recommended for adoption. A change in the system of reinstatement, whereby members whose membership lapsed prior to May 1, 1898, were given the option of new membership or reinstatement on the present terms, was recommended.

In the election of officers for the coming year Mr. J. R. Lusk, of the Pittsburgh & Western, was elected President by acclamation. Mr. John P. Mann was, after a vigorous struggle, elected Vice-President. Mr. J. F. Mackie was unanimously re-elected Secretary-Treasurer and Editor for two years. Messrs. J. W. Cuineen, of the Lehigh Valley, Auburn, N. Y.; A. D. Caulfield, of the Yazoo & Mississippi Valley, of Wilson, La.; F. S. James, of the Illinois Central, Cherokee, Iowa, and G. H. Brown, of the Denver & Rio Grande, Alamosa, Col., were elected members of the Executive Committee. San Francisco was selected for the place of next meeting, and June 11, 1901, was fixed as the date.

The reception accorded the members at Atlanta surpassed anything given at any previous annual meeting, and was worthy of the far-famed reputation of the South for hospitality. There were 75 members present at the various sessions and 46 new members were elected.

TECHNICAL.

Manufacturing and Business.

W. D. Sargent, General Manager of the Sargent Co., Chicago, returned from Europe Saturday last, the 23rd, after a two months' trip.

Edward E. Gold, Frankfort and Cliff streets, New York City, has issued a circular in reference to the Gold platform gate lock, of which over 12,000 are in use. The circular describes in detail the working of the lock and states that it is in satisfactory service on all the cars of the elevated roads in New York, Chicago and Brooklyn and has also been applied to the cars of the London Central (underground), the Illinois Central (suburban) and Staten Island Rapid Transit Companies. It will also be used on the Boston Elevated.

The Engineering Contract Co., Great Bend, Jefferson County, N. Y., wants for two weeks or sooner delivery, one 36-in. gage locomotive, 15 to 20 tons, capable of turning 40° curves.

The Philadelphia Machine Tool Co., 445 North Darien street, Philadelphia, has recently added to its works a department for building machinery and apparatus for use in physical tests of materials. Joseph W. Bramwell, recently Engineer and Manager of Riehle Bros. Testing Machine Co., and editor of the *Digest of Physical Tests*, will have special charge of this department.

On one day recently the Robert Aitchison Perforated Metal Co., of Chicago, received in its first mail, orders from Vermont, Utah, Minnesota and Louisiana.

The Pneumatic Tool Implement Co., Camden, N. J., has been incorporated to make pneumatic machines, etc. The incorporators are: J. W. Duntley, W. C. Strowbridge and T. Alcorn. The capital is $150,000.

Henry W. Toothe, who has been in the railroad supply business for the past 22 years, having left railroad service for that purpose, and who, for the past 11 years, has represented the Midvale Steel Co., of Philadelphia, has resigned; the resignation to take effect July 1. He has accepted a territorial agency for the Chicago Pneumatic Tool Co., and will make his headquarters at Denver. Mr. Toothe has an extensive acquaintance, both in the East and West, and, having been engaged in mechanical work for the greater part of his life, he thoroughly knows his work.

The Western Railway Equipment Co. and the Missouri Railway Equipment Co., both of St. Louis, Mo., have consolidated and the new corporation will be known as the Western Railway Equipment Co., with offices in the Union Trust Building, St. Louis. F. Reardon, formerly Superintendent of Motive Power and Car Department of the Missouri Pacific, at St. Louis, will be President and General Manager. Through this consolidation of interests all infringement suits existing between the old companies are withdrawn.

The International Air Brake Co. has been incorporated, with a capital of $2,000,000, by H. Van Wagener, H. G. Schackno and C. W. Tracey, of New York; I. Smith, of East Orange, N. J., and O. H. Leonard, of Elizabeth, N. J. The company will make air-brakes.

Iron and Steel.

The Bethlehem Steel Co. has signified its intention of bidding for the entire contract for 36,000 tons of armor plate for the Navy Department.

The firm of Witherbee, Sherman & Co. was incorporated in New York June 25, with a capital of $3,000,000, to mine and sell iron and other ores, etc., and make iron and steel. The office will be in the town of Noriah, Essex County. The directors and principal shareholders are: Walter C. Witherbee and Frank S. Witherbee, of Port Henry, and George D. Sherman, of Crown Point; Wallace T. Foote, Jr., Port Henry; Lewis W. Francis and John R. Sherman, Port Henry.

The headquarters of the American Steel Hoop Co. has been moved from Pittsburgh, Pa., to the Battery Park Building, New York.

The Birmingham and Gate City rolling mills of the Republic Iron & Steel Co. have been ordered closed from July 1.

A consolidation of a number of tool steel plants is reported about effected. The Pittsburgh plants include those of the Park Steel Co., Singer, Nimich & Co., Firth-Sterling Steel Co., and the Anderson DuPuy Co. Other plants included are those of the Collins Co., Hartford, Conn.; Chrome Steel Works, Brooklyn, N. Y.; Monhagen Steel Works, Middletown, N. Y.; Heller Bros., Newark, N. J., and Disston & Sons, Philadelphia. The proposed capital of the new company is $50,000,000, equally divided into preferred and common stock, the former bearing 7 per cent. cumulative dividends.

Negotiations are in progress between the Niles-Bement-Pond Co. and the Pratt & Whitney Co. for the acquisition of the latter by the former company. The plan of consolidation, according to report, provides that holders of the preferred stock of the Pratt & Whitney Co. shall receive an amount equivalent to 70 per cent. of their holdings in a new 6 per cent. cumulative preferred stock guaranteed by the Niles-Bement-Pond Co. The remaining 30 per cent. of the present Pratt & Whitney preferred stock will be exchanged for the new common stock, and under the plan, is to be bought by the Niles-Bement-Pond Co. at $10 per share. The present outstanding $1,000,000 of P. & W. common stock will be bought by the N.-B.-P. Co. at $10 per share. The Pratt & Whitney Co. was organized in 1892, and its authorized capital stock is now $3,000,000, of which $2,000,000 is 8 per cent. cumulative preferred stock and $1,000,000 common stock.

Mr. B. Kusakabe, an engineer in the Japanese Department of the Interior, is visiting the United States with two other Japanese engineers to make a scientific study of bridges, levees and the protection of land from overflow. The Japanese Government has appropriated $3,000,000 to be expended on one of the largest and most troublesome rivers in Japan.

The work of removing the Lackawanna Iron & Steel Company's mills from Scranton, Pa., to Buffalo, N. Y., has been begun. The mills employ about 3,000 men.

The American Nickel Steel Co., Wilmington, Del., has been incorporated in that state to make steel. The capital is $100,000.

A consolidation of five pipe-bending concerns, located in the Pittsburgh District, will be consummated by July 1, according to report. The prospectus of the Pittsburgh Valve & Construction Co., the new concern, states that the following companies will be absorbed: Atwood & McCaffrey, Best Mfg. Co., Pittsburgh Valve & Machine Co., Shook-Anderson Mfg. Co. and the pipe fitting plant of the Wilson-Snyder Mfg. Co. The new company will carry on the business of pipe, valve and steam fitting, pipe bending and manipulation where high steam pressure is used. The new company has the exclusive use of a new machine for the cold bending of pipe. The proposed capital is $4,000,000; half will be preferred stock, entitled to 7 per cent. cumulative dividends. Options on the plants have been extended to July 2.

Fireproof Wood.

Last week a distinguished party of representative business men gathered at the yard of the New York Shipbuilding Co., in Camden, N. J., to see a test of fireproof wood treated by the Ferrell process, the patents for which are owned by the U. S. Fireproof Wood Co. of Philadelphia. Two small buildings were put up, each 8 ft. square x 12 ft. high. One was of ordinary wood, the other of treated wood. These little buildings were liberally supplied with piles of shavings, cotton waste and kindling wood saturated with oil. In 16 minutes after this material was lighted the building of untreated wood was in ruins, while the other showed no traces of the fire except a thin, charred, blackened surface, where the flames had come in direct contact with it. Wood soaked in oil was again piled in this house and again lighted, the heat being such as to break and even melt the glass, but the structure itself could not be set on fire. In another test a small structure was pretty well filled with electric wires, and the current turned on, with the result of blackening the wood at places where the wires touched it. In still another test a Bunsen blast was blown against the wood, merely charring it.

This process treats wood either green or dry at a cost little more than untreated wood. A non-volatile chemical solution is used which is forced into the wood under hydraulic pressure. The New York Fireproof Wood Co. is now building a plant at Long Island City capable of treating 15,000 ft. of lumber annually. The United States Fireproof Wood Co. is, we believe, the parent company. The President of this company is Mr. Samuel Huckel, Jr., and the Vice-President Mr. John C. Sims, Secretary of the Pennsylvania Railroad.

Rolling Stock for Italy.

The Italian Government has authorized the Italian Southern Railroad Co. to invite tenders for 18 locomotives, 121 passenger cars, 1,000 freight cars and 32 baggage cars. Foreign competition will be admitted. The Southern is one of the largest railroad systems of the kingdom. At the end of 1899 the company owned 1,168 locomotives, 3,969 passenger cars, and 21,716 freight cars. The gage of the road is 1.435 meters, and the mileage amounts to 3,568 miles. The head officers of the Southern Railroad Co. (Societa Italiana per le Strade Ferrate Meridionali) are at 93 Borgo Pinti, Florence. Comm. Ing. S. Borgnini is the Director General of the company, and Baron Comm. Ing. C. de Bottini is the Secretary.

Locomotive Building in 1900.

At the Master Mechanics' Convention during one of the discussions Mr. Vauclain said that the Baldwin Locomotive Works will build during the year 1900 twelve hundred locomotives. Of these 400 are for export and 450 of the total number are compounds. On this basis we may make the guess that the locomotive building for the year in the railroad contract shops will be about 3,000.

Officers of the M. C. B. Association.

The following officers of the M. C. B. Association were elected at the Saratoga meeting to serve during the ensuing year: President, J. T. Chamberlain, Boston & Maine; First Vice-President, J. J. Hennessey, Chicago, Milwaukee & St. Paul; Second Vice-President, J. W. Marden, Fitchburg R. R.; Third Vice-President, F. W. Brazier, New York, Central & Hudson River. Executive Committee: E. D. Bronner, Michigan Central; J. H. McConnell, Union Pacific, and William Apps, Canadian Pacific. Treasurer, John Kirby, Lake Shore & Michigan Southern.

Officers of the Master Mechanics' Association.

At the Saratoga meeting the following were elected officers of the Master Mechanics' Association to serve during the ensuing year: President, W. S. Morris, Chesapeake & Ohio; First Vice-President, A. M. Waitt; New York Central & Hudson River; Second Vice-President, J. N. Barr, Baltimore & Ohio; Third Vice-President, G. W. West, New York, Ontario & Western, and Treasurer, Angus Sinclair.

THE SCRAP HEAP.

Notes.

On the night of June 21 a passenger train of the St. Louis, Iron Mountain & Southern was stopped by robbers near Olla, La. The express messenger was made to give up $31.

The Supreme Court of New Jersey has rendered a decision in a suit of the administrator of a brakeman, who was killed last year—the suit being brought to test the

validity of the agreement of the deceased which he made in joining the Relief Association—holding that only actual acceptance of benefits deprives the man of the right to sue for damages for injuries received, and only the actual acceptance of death benefits by the widow and next of kin deprives them of their right under the death act to sue for damages. The case was that of the administrator of Cornelius McKering. McKering belonged to the Relief Association, and signed the usual agreement, making his sister his beneficiary. The sister accepted the benefits, and signed a release, and the court raises a question which it does not decide, as to whether the sister, as one of the next of kin, is entitled to sue for damages. It holds that the others are. The court intimates that a person is not entitled to be compensated twice, but holds that under the agreement signed by members of the Relief Association it is only that actual acceptance of the relief benefit that operates as a waiver of the legal right to sue for damages.

Traffic Notes.

Press dispatches report the consolidation of the Florida East Coast Steamship Company and the Plant Steamship lines.

Chicago press dispatches report continued rate-cutting on freight from that city to the Atlantic Seaboard, but the charges do not seem to be very definite.

William Lantell, the block signal operator whose neglect caused the collision in the Baltimore & Ohio tunnel at Philadelphia May 11, has been indicted by a grand jury for murder.

Chicago papers report that ticket brokers in that city, acting in conjunction with brokers in New York, have been doing a large business between those two cities on round-trip half-rate tickets issued for the Republican National Convention at Philadelphia.

The Southern Pacific has made a reduction in the rates on rice from the fields of Southwestern Louisiana, amounting to about 3½ cents per 100 lbs. It is said that this is the result of a compromise made at a conference of the railroad company, the State Railroad Commissioners and the principal rice growers.

Three hotel clerks have been arrested at Philadelphia for ticket scalping. The Pennsylvania law against speculation in tickets is a rigid one, and we have heretofore understood that it was effective; but the Philadelphia *Inquirer*, reporting the present arrests, says that scalping has been going on in that city for years.

The majority of the roads terminating in St. Louis have all extra baggage weighed at destination. To check the work of the baggage agent at the starting point, and to further extend this practice, these roads have requested the Terminal Railroad Association to thus weigh all baggage delivered by the several roads at the Union Depot.

In the Court of General Sessions at New York city June 22 W. J. Blase was convicted of selling counterfeit tickets. In September, 1899, Blase and another opened a ticket office in the Astor House, New York, and sold a large number of what purported to be return portions of excursion tickets sold by the Colorado Midland, but which the road never issued.

At the annual meeting of the East Carolina Truck and Fruit Growers' Association, held in Wilmington last week, it was stated that the reductions in the charges on fruit shipped to the North in refrigerator cars, which the Atlantic Coast Line made for the benefit of the Association this year, saved to strawberry shippers $82,627.39, and but for this saving the profit this year would have been too low to justify the risk involved in raising and marketing berries. The net returns were 75 cents a crate; if last year's freight rates had been paid the profit would have been only 47.5 cents a crate. The officers of the Association complained that the Southern Express Co. was unreasonable in withholding desired reductions of rates.

The executive officers of the lines between New York and Chicago agreed last week that differential fares between these cities, based on the speed of trains, should be strictly enforced, and it is said that, beginning with the present week, fares on a number of trains will be advanced. For several years there has been an agreement that on trains traveling between the two cities in less than 28 hours the fare should be higher than the standard; $1 above the standard (of $20) for each hour of reduction in time, but on the eastbound trains the agreement has been poorly lived up to. Disregard of its provisions lately led to the Erie's notice of withdrawal from the Joint Passenger Committee. The Lake Shore, the Michigan Central, and the Wabash are the roads most affected by the decision to charge excess fares. Except on the Pennsylvania and Lake Shore limited trains, on which excess fares have been charged, no trains are run through between Chicago and New York in less than 26 hours, so that two dollars will be the largest excess fare to be imposed.

Conference of Western Presidents.

The Presidents of the roads west of Chicago met in that city last week to complete the business begun in New York the week before. The local committees established at the principal cities will each have a general agent as follows: St. Louis and Texas committee, E. B. Boyd, General Freight Agent of the Rock Island lines east of the Missouri River; Kansas City committee, H. H. Courtwright, of the Western Freight Association; Omaha committee, C. L. Wellington, formerly of the Western Freight Association; St. Paul and Minneapolis, C. N. Osgood. These agents are to keep a close watch for rate disturbances, with a view to securing the promptest possible action by the committees in case any member is accused of making secret reductions. These two conferences, that at New York and that at Chicago, appear to be looked upon by the officers interested as having been decidedly useful. One of these officers says:

"The January meeting, held in New York, was productive of much good, as it brought together a body of executive officers of railroad companies with representatives of the Interstate Commerce Commission to an extent that had not been before accomplished. Over 60 Western railroads were represented at that time, and the harmony that prevailed and the action had gave promise of excellent results in the maintenance of published rates and the observance of lawful methods in the conduct of interstate traffic.

"The great reform of abolishing throughout the United States the payment of commissions on ticket sales was then accomplished, and notice to that effect was shortly after given to all ticket agents throughout the country. This was followed by all the Mexican railroads taking similar action. Subsequently the Canadian Pacific gave practical and substantial support to this new and sensible departure, and has since co-operated with the United States lines in adhering to the reform.

"At the March conference, also held in New York, the proceedings of the January meeting were followed by more decisive action, and the general rate situation, both as to passenger and freight traffic, was materially improved and greatly strengthened.

"The various railroad officers in attendance at the conferences just adjourned feel very hopeful of establishing permanent methods whereby adherence to published tariffs and a general maintenance of passenger and freight rates will be secured."

The next quarterly conference will be held in New York City early in September.

Passenger Train Disaster at McDonough, Ga.

On the night of June 23, about 9 o'clock, a passenger train of the Southern Railway was derailed in consequence of the weakening of the roadbed by a flood, and every person on the train, except those in the rear car, was killed. The latest reports give the number of fatalities as 41. All of the train crew, except the rear brakeman, lost their lives, and of the other victims a considerable number were employees of the road off duty, some of them being trainmen on their way home, and others track repairmen going to repair flood damages.

The derailment occurred on a bank about 50 ft. high, and from the accounts it would appear that a brick and stone culvert at the bottom of this bank was washed out by a flood which suddenly rose to a height above the top of the masonry. One account says that the roadbed had been inspected and declared safe only half an hour before. That portion of the wreck which lodged above the water at once took fire, and was burned up, and the flames made it impossible to give help to the persons who were pinned in the wreck. The sleeping car, the rear car of the train, lodged on top of the other cars. Some of the occupants of this car were injured. Heavy rains had been falling throughout a large part of Georgia for several days, but it is said that at the point in question an unusually heavy rain, or cloudburst, must have occurred.

Another Passenger Train Accident.

Twelve persons are reported as having been killed or fatally injured in a butting collision on the Chicago & Northwestern, near De Pere, Wis., on Sunday morning last. An excursion train carrying 600 passengers collided with a freight train drawn by two engines. The first three cars of the passenger train were crushed, and the wreck took fire, and was partly burned up. Many of the injured passengers were burned.

LOCOMOTIVE BUILDING.

The Buffalo Creek has ordered one engine from the Brooks Locomotive Works.

The Longdale Iron Co. has ordered one engine from the Baldwin Locomotive Works.

The Richmond, Fredericksburg & Potomac has ordered two 10-wheel engines from the Richmond Locomotive & Machine Works, to be exact duplicates of two engines now building for the same road. They are for January delivery and will have 19-in. x 26-in. cylinders and weigh in working order about 140,000 lbs.

The Richmond Locomotive & Machine Works are shipping to the Paris Exposition, on the French Line Steamship Bordeaux, one 10-wheeled locomotive, with 16-in. x 24-in. cylinders, built for the Finland State Railways. This is one of 10 engines, nine of which have already been shipped to the road at Helsingfors.

The St. Louis & San Francisco in April ordered 18 consolidation engines from the Dickson Locomotive Works. These are now being built and will weigh 157,000 lbs. with 140,000 lbs. on the driving wheels, and have 21-in. x 28-in. cylinders, 57-in. driving wheels, straight top, crown bar, boilers, with a working steam pressure of 190 lbs., and 250 tubes 2 in. in diam. and 14 ft. long; fire-boxes, carbon steel, 108 in. long and 41¼ in. wide; and a tender capacity for 5,000 gals. of water and eight tons of coal. The special equipment includes Sterlingworth brake-beams, Trojan couplers, Monitor headlights, Nathan simplex injectors, U. S. Metallic piston and valve rod packings, Consolidated safety valves, Houston pneumatic sanding devices, Ashcroft steam gages, Johnstone blow-off cocks and Linstron non-freezing suction pipes.

CAR BUILDING.

The Baltimore & Ohio is figuring on two dining cars.

The Grand Trunk is asking bids on from 300 to 500 coal cars of 80,000 lbs. capacity.

The Delaware & Hudson order for 100 steel cars, referred to last week, was placed with the American Steel Foundry Co., instead of the American Car & Foundry Co., as stated.

The Delaware, Lackawanna & Western is in the market for from 300 to 500 coal cars of 80,000 lbs. capacity. The order will be placed soon, as the cars are to be delivered before October.

The Shreveport & Red River Valley Ry. Co., as noted last week, has ordered 65 box and 35 flat cars of 60,000 lbs. capacity of the American Car & Foundry Co. The special equipment includes National Hollow brake beams, American Car & Foundry Co.'s doors, trucks and bolsters, Christie brake shoes, Westinghouse air-brakes, Smith Safety couplers, cast-iron journal boxes with pressed steel lids, Winslow roofs and French springs.

BRIDGE BUILDING.

AKRON, O.—City Engineer J. Payne, according to report, estimates that a viaduct from College street to Point Lookout Landing will cost $18,563.

ALBION, MICH.—We are informed that an election will be held July 2 to decide if the city shall build a bridge over the river.

APPLETON, WIS.—The Chicago & Northwestern, according to report, is considering building a 600-ft. steel bridge across Fox River at this place.

BLAIR, ONT.—Bids are being received by the Council of the Corporation of the Township of Waterloo for building a new bridge over Speed River. It will be of two spans, each 53 ft. long, with 16-ft. roadway. Geo. A. Till, Township Clerk, Blair, Ont.

BOSTON, MASS.—The following bids were opened, June 11, for rebuilding the Malden bridge over Mystic River. W. J. Lawler, $66,079; W. L. Miller, $73,839; T. E. Ruggles, $74,575.30; W. H. Ellis, $89,300; George Hayes, $91,000; Joseph Ross, $91,200. All of Boston. The contract is let to W. J. Lawler. The bridge is 812 ft. long.

Bids for building eight masonry piers for the Cambridge bridge are wanted, July 23, as stated in our advertising columns. Wm. Jackson, City Engineer.

BUFFALO, N. Y.—The Finance Committee of the Board of Aldermen has reported in favor of taking $11,745 from the unused dredging fund and applying the amount towards building the bridge over Buffalo Creek at Seneca and Elk streets. (June 2, p. 431.)

CASSEL P. O., ONT.—Bids are wanted for five bridges until July 13, by Louis Kaufmann, Bridge Commissioner, Cassel P. O., County of Oxford.

CHICAGO, ILL.—A representative of the Pennsylvania Co. is reported as stating that the track elevation ordinance passed by the Council June 18 would be accepted by his company.

Reports state that the Board of Trustees of the Sanitary District have decided to build a bridge across the canal at California avenue.

CLEVELAND, O.—Plans are being made for a rolling lift bridge to replace the present Middle Seneca street bridge. The new bridge will cost about $100,000.

COLORADO SPRINGS, COLO.—The Colorado Springs & Cripple Creek R. R. proposes to build bridges or subways at crossings of the Denver & Rio Grande.

DAVENPORT, IA.—The Chicago, Rock Island & Pacific has submitted plans to the Council for track elevation in Davenport. Bridges will be built at Perry, Brady, Main, Harrison and Ripley streets.

EDDYVILLE, IA.—We are informed that the substructure of the Des Moines River bridge at Eddyville, being built by the Iowa Central Ry., will be finished during July. The substructure consists of seven piers of sandstone, with concrete interior. The superstructure will consist of seven riveted through spans, 136 ft. 6 in. long, and designed for Waddell's Class U loading. The contract for the superstructure has not been let but bids may be asked soon. Waddell & Hedrick, of Kansas City, Mo., are consulting engineers on the work.

The Iowa Central will also strengthen several old spans this year.

EUREKA, CAL.—County Surveyor Pine is authorized to make plans and specifications for a bridge across the Mosley Slough on the Cannibal Island Road.

Plans are about finished for the proposed bridge across the Van Duzen River, near Alton. (May 25, p. 346.) The cost of the bridge will be between $25,000 and $30,000. It will probably be a combination bridge of two spans.

FREDERICK, MD.—The Board of County Commissioners has voted to build an iron bridge across the Monocacy River at Reich's Ford. It is estimated the bridge will cost about $12,000.

GLENDIVE, MONT.—Bids are wanted, until July 13, for the superstructure of the bridge over Yellowstone River which will have three spans 308 ft. 6 in. long. James McCormick, Clerk.

GLOUCESTER, MASS.—City Engineer Webber informs us that plans are now before the Massachusetts Harbor & Land Commissioners for a new bridge to replace the present Squam bridge. The structure is 445 ft. long, 40 ft. wide. The probable cost of the finished structure is $25,000.

GUNNISON, COL.—The Colorado & Southern R. R. Co.'s iron bridge across the Gunnison River, 2½ miles above this town, was wrecked by an explosion, June 21.

HOLYOKE, MASS.—The bids for a bridge on Cabot street over the Second Level Canal, opened June 15, varied from $17,780 to $21,356 for a metal bridge, and from $28,209 to $36,343 for a stone bridge. F. H. Keepers & Co. submitted two plans for a concrete steel bridge, their offers being $36,700 and $33,500.

JERSEY CITY, N. J.—John P. Egan, Clerk of the Board of Chosen Freeholders of Hudson County, informs us that nothing definite has been done as yet in regard to rebuilding the Paterson Plank Road bridge. The committee having the matter in charge will probably report at the meeting of the Board on July 5. The present bridge is about 440 ft. long. (June 22, p. 432.)

LEWISTON, CAL.—Bids are wanted, July 11, by the Board of Supervisors of Trinity County for a combination bridge 180 ft. long over Trinity River. (March 16, p. 176.) H. C. Ingram, County Surveyor, Weaverville. See also Weaverville, below.

LISTOWEL, ONT.—The County Council has appointed a commission to build a proposed steel bridge on the town line between Elma and Mornington.

Another committee has been appointed to arrange with Oxford County to build a steel bridge replacing Finnie's bridge on the south boundary between Perth and Oxford.

MACON, GA.—Seventeen bridges have been washed away in Bibb County, according to local report, since the rainy season set in.

MARIETTA, O.—A franchise has been asked of the city by the Ohio River Bridge & Ferry Co. for right of way on Third street to bridge the Ohio River at that point.

MINEOLA (L. I.), N. Y.—The Long Island R. R. will abolish the grade crossings in this town.

NEWHALL, MICH.—See North Escanaba, Mich.

NEWPORT, ORE.—The County Court ordered that bids for a bridge across Five Rivers near Fisher's school house, be advertised for, and be opened on the first day of the July term.

NEW YORK, N. Y.—George C. Clausen, Chairman of the Park Board, wants bids until 11 a. m., July 3, for the viaduct carrying Riverside Drive over Ninety-sixth street and extending from Ninety-fifth to Ninety-seventh street. The plans were made by Boller & Hodge, 1 Nassau street, New York. (June 8, p. 378.)

NORTH ESCANABA, MICH.—The Minneapolis, St. Paul & Sault Ste. Marie will build a 500-ft. girder bridge over the Escanaba River at this place at a probable cost of $42,000. Other bridges to be built are a 90-ft. steel girder bridge, estimated to cost $6,500, over Sturgeon River, at Sturgeon River, Mich.; a 96-ft. steel girder bridge over Ten-Mile Creek, estimated to cost $6,000, and a 152-ft. steel girder bridge over Ford River, estimated to cost $10,600, both at Newhall, Mich. Another girder bridge of 75 ft., which will probably cost $6,000, will be built at Plymouth avenue, in Minneapolis, Minn. The company has recently finished a 20-ft. stone arch bridge

165 ft. long over Bassett Creek in Minneapolis, at a cost of $13,000. Thomas Greene, Chief Engineer, Minneapolis.

OLYMPIA, WASH.—The Commissioners of Thurston County will receive bids, July 3, for a Howe truss bridge of two spans, one 80 ft., and the other 90 ft., across the Des Chutes River. R. A. Graham, County Auditor.

PITTSBURGH, PA.—We are informed that the building of a bridge across Junction Hollow from Wilmot street to Schenley Park has been postponed for the present and the advertisement withdrawn. The roadway of the bridge is to be about 880 ft. long and the main span 450 ft. The roadway will be 20 ft. wide, and there will be two sidewalks 10 ft. wide each. George W. Wilson has succeeded Mr. E. M. Bigelow as Director of the Department of Public Works.

Major C. F. Powell, Corps of Engineers, U. S. A., stationed at Pittsburgh, has suggested to the city a plan to raise the bridges over the Allegheny River, in the center without material change to either shore end.

PORTSMOUTH, O.—Bids are wanted until July 2 for building the superstructure of an iron or steel bridge over Little Scioto River at American P. O. The bridge will be 152 ft. 4 in. long and 14 ft. wide. Lafayette Jones, County Surveyor; M. H. Shumway, County Auditor. (April 27, p. 278.)

REGINA, N. W. T.—Bids are being received, according to report, for a bridge over Whitemud River. Plans and specifications are with John A. C. Cameron, local inspector, at Edmonton. Bids to be sent to J. T. Dennis, Deputy Commissioner of Public Works, Regina, N. W. T.

ROME, N. Y.—A new bridge will probably be built over Fish Creek, at Brodock's, to replace the structure generally called Brodock's bridge.

ST. CATHARINES, ONT.—The contract for the foundation work for the bridge over the old Welland Canal for the Niagara, St. Catharines & Toronto Ry. is let to Munford & Nicholson at about $12,000. The culvert masonry for the line was let to Bennett & Boyd, and the earthwork to John Fay. The superstructure has not yet been let. F. A. Cheney, General Manager.

SYRACUSE, N. Y.—The State Railroad Commissioners held a meeting in Syracuse last week to give hearings on petitions for abolishing grade crossings in the town of Geddes.

TRACY, CAL.—A bridge has been petitioned for across the San Joaquin River at Dunham's Ferry.

The County Surveyor has been ordered to make plans for a steel bridge across the Calaveras River on the Lower Sacramento Road.

VICKSBURG, MISS.—Bids are wanted, July 2, according to report, for a bridge over the A. & V. Ry. J. D. Laughlin, Chancery Clerk.

VINCENNES, IND.—Bids are wanted, August 7, for three steel bridges, with stone abutments, according to plans and specifications on file in the Knox County Auditor's office. James D. Williams, County Auditor; J. S. Spiker, Engineer.

WACO, TEX.—At an election, held June 15, it was voted to issue bonds to pay half the cost of a steel bridge, on stone piers, across the Brazos River. McLennan County will pay the other half of the cost.

WEAVERVILLE, CAL.—At the July meeting the Board of Supervisors of Trinity County will order plans and specifications made for a combination bridge at Lowden's Ranch, nine miles from Weaverville. See also Lewiston, above.

WELLAND, ONT.—The County Council will petition the Dominion Government to build a steel bridge in place of the Montrose bridge at Chippewa.

WEST ALEXANDRIA, O.—The Cincinnati Northern has let a contract to the Toledo Bridge Co. for a bridge 300 ft. long, of steel trusses on stone abutments and piers, over Big Twin Creek, one mile south of West Alexandria, at $26,000. H. W. Tapp, of Fort Wayne, Ind., will build the foundations.

YORK, PA.—The Commissioners of York County received bids, June 28, for masonry work for bridges at Raynolds' Fording, near Porter's siding; Green Ridge, at Green Ridge Station, Western Maryland, R. R.; Kelley's Fording over Muddy Creek, near Muddy Creek's Fork station. Chas. M. Motter, Clerk.

ZANESVILLE, O.—The County Commissioners, on June 14, received bids, with plans, for the Y bridge over the Muskingum and Licking Rivers at Zanesville.

Rarig Engineering Co., Columbus, concrete, $55,000; Toledo Bridge Co., steel, $99,000 and $139,870; Wabash Bridge Co., steel, $98,646; Brackett Bridge Co., $119,000; Pittsburgh Bridge Co., 16 plans, ranging in cost from $60,000 to $216,000; Wrought Iron Bridge Co., six plans, ranging from $129,900 to $200,000; Adams Bros. & Co., Zanesville, concrete, $169,850; Thomas O'Herne and Ed. Berrigan, Yonkers, concrete-steel, $190,000; A. & P. Roberts Co., 10 plans, ranging from $168,000 to $205,000; New Columbus Bridge Co., four plans, $153,400 to $236,000; Stamson & Bloom, Chicago, concrete, $190,000 and $232,000; Williams Bros. & Morse, Cleveland, concrete, $215,000; Berlin Iron Bridge Co., $188,000 and $199,964; King Bridge Co., 14 plans, with prices ranging from $146,173 to $184,000. The Osborn Co., Cleveland, will report on the plans.

Other Structures.

BALDWIN, MICH.—The Great Northern Portland Cement Co. will build a cement factory in Baldwin. The company is capitalized at $5,000,000, and owns about 6,000 acres of land in the vicinity of Baldwin. George Anderson, of Detroit, and Alexander B. Scully, of Chicago, are interested.

DAVENPORT, IA.—The Chicago, Rock Island & Pacific proposes to build a depot between Main and Harrison streets, in connection with track elevation.

DETROIT, MICH.—The Citizens Street Ry. Co., according to local reports, will build a union freight terminal at the corner of Second and Front streets.

ELKTON, MD.—The J. F. Powers Foundry Co., of Elkton, has bought a tract of land opposite the Elkton freight station on the P., W. & B. R. R., on which to build a foundry.

LANCASTER, PA.—A site is being considered by the Philadelphia & Reading for a new passenger station in Lancaster. Preliminary plans are reported made.

LEVIS, QUE.—The Hon. R. R. Dobell has notified the Mayor of Levis that the proposed improvements will soon be begun. They will cost about $300,000 and include a new station and new wharves. The old station will be used as a custom house and postoffice.

OTTAWA, ONT.—It is reported that the contract for the new Canada Pacific station on Broad street has been awarded to Mr. Piggott, of Hamilton, at $40,000. It will be of white brick with stone trimmings.

PITTSBURGH, PA.—Contractor H. S. Kerbaugh, who is building the yards for the new Pittsburgh Union Depot, has the contract for removing the old passenger station.

MEETINGS AND ANNOUNCEMENTS.

(For dates of conventions and regular meetings of railroad associations and engineering societies see advertising page xiii.)

The Railway Transportation Association.

The summer meeting of the Railway Transportation Association will be held at the Hotel Cadillac, Detroit, Mich., 10 a. m. Wednesday, July 18. Committees will report on the following subjects: "General Transportation Topics," "Car Service," "Interchange and Distribution," "Tonnage Rating of Engines," "Loading Freight Cars to Their Full Capacity," and "First Choice and Second Choice Method of Settlement for Car Hire." An election of officers and of two members of the Executive Committee will be in order at this meeting. G. P. Conard, Secretary, 24 Park Place, New York.

Iron and Steel Institute.

The Autumn meeting of the Iron and Steel Institute (British) will be held at Paris, on Tuesday and Wednesday, Sept. 18 and 19, 1900. Mr. Henry Chapman, who was Honorary Secretary at the meetings of the Institute in Paris in 1878 and in 1889, has placed his office, 10 Rue Laffitte, at the disposal of the Institute. His manager, Mr. Henri Vaslin, has consented to act as Honorary Lord Secretary, and an influential Reception Committee is being formed. Arrangements will be made for visiting the different sections of Metallurgy, Mining, Machinery and Railway Plant at the Exhibition, under expert guidance; and Mr. Henri de Wendel, Bessemer Gold Medallist, has intimated his intention to invite a limited number of the members to visit the works of his firm at Joeuf and Hayange, after the meeting.

The Car Foremen's Association of Chicago.

The regular meeting of the Car Foremen's Association of Chicago was held in the Monadnock Building Thursday evening, June 14, 52 members being present. A number of new names were added to the membership list.

The discussion on responsibility for broken draft timbers, head block, timber bolts, carry irons, etc., in connection with a missing coupler, was continued with much interest, and occupied the greater part of the evening. It was finally decided, however, that unless the missing coupler could be produced, and it and its attachments found in good condition, no charge should be made for the draft timbers, etc. If, however, the coupler and attachments were found to be itnact, a bill would be proper for the replacement of the draft timbers, etc.

In regard to the labor charge for the removal and replacement of one brakehead or fork on metal brakebeams, in cases where they are riveted on, it was decided that three hours' labor would be a proper charge, as in most cases the brakebeam would have to be taken down and the beam taken to the blacksmith shop to have the new head riveted on. As the M. C. B. Rules allow a labor charge of two hours for the removal and replacement of a brakebeam, another hour should be allowed for the labor of replacing the defective head.

Question No. 3, "In case of renewal of a broken coupler and a broken carry iron at the same end of a car, what is a proper charge?" did not develop much of a discussion. Some roads had received bills for three, and even four, hours for this work, but there was no one at the meeting who took that view of it, the general opinion being that the two hours allowed by the M. C. B. Rules for the replacement of a coupler was all that could be charged, as the carry iron has to come down anyhow in replacing a coupler.

PERSONAL.

(For Other personal mention see Elections and Appointments.)

—Mr. W. Macmillan, Assistant General Freight Agent of the Michigan Central, died suddenly in Portland, Ore., Wednesday, June 20.

—Mr. Walter W. Taberner, General Agent of the Armour Car Lines and Fruit Growers' Express, has resigned to engage in business for himself.

—Mr. J. D. Layng, Vice-President of the Cleveland, Cincinnati, Chicago & St. Louis, was on June 14 elected Trustee of the Western University of Pennsylvania. At the same time the degree of LL.D. was conferred upon him. Mr. Layng is a graduate of this university.

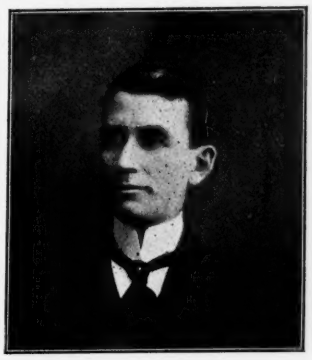
—Mr. E. Raymond on June 1 became Superintendent and Roadmaster of the Southern Kansas of Texas line of the Atchison, Topeka & Santa Fe at Amarillo, Tex. He was born in Kendall Corners, Orleans County, N. Y., in May, 1858. He removed to Kansas in 1875, and began service with the Atchison in January, 1877, as a track laborer, and has continued with that company without intermission until the present. He was promoted to Section Foreman in March, the following year, and to Roadmaster in July, 1886. In August, 1893, he was made General Roadmaster of the Chicago Division, the position he held at the time of his recent change to that of Superintendent and Roadmaster of the Southern Kansas of Texas line.

—Mr. Aaron Johnston has been appointed Engineer of Maintenance of Way for the Central of Georgia, with headquarters at Savannah, Ga. He was born March 25, 1865. For five years, from 1885, he was employed by the Norfolk & Western as rodman, instrument man, topographer and assistant to the Resident Engineer on division terminal improvements at Crewe, Va. Since that time he has been with the Richmond & Danville as Assistant Engineer of Maintenance of Way in 1892 and 1893; with the Georgia Pacific in a similar capacity in 1894; as Assistant Engineer on the Southern Railroad in 1894, and as Inspector of Timber on the same road in 1895. During the year 1896 he was Superintendent in charge of construction of the county court house at Harrisonburg, W. Va. For the past three years he has been Assistant Engineer on the Central of Georgia.

—Mr. Frank Harriot, as already noted, is to become Eastern Freight Traffic Manager of the Erie at 21 Cortlandt street, New York, in charge of lines east of Buffalo and Salamanca. Mr. Harriot has been the General Freight Traffic Manager, but after July 1 will divide his work with the Fourth Vice-President, Mr. G. G. Cochran, who is to have headquarters at Cleveland, O., as the Western Freight Traffic Manager. Mr. Harriot was educated in the schools of New York and Elizabeth, N. J. He entered railroad service in 1872 as Contracting Agent for the Baltimore & Ohio, and since that time he has been for three years Contracting Agent at New York and Chicago; for six years General Agent at Chicago; from 1881 to 1888 General Freight Agent, and until 1896, General Freight Traffic Manager of the road at Baltimore. He left the Baltimore & Ohio in March, 1896, for his position with the Erie.

—Mr. B. F. Yoakum, who on June 7 was elected President and General Manager of the St. Louis & San Francisco, was born in Limestone County, Tex., in 1856. His first railroad experience was in construction work with the International & Great Northern while it was building from Troupe, Tex., to Palestine. After the building of the road, Mr. Yoakum took a position in the Passenger Department. Later he was Division Freight Agent, with headquarters at San Antonio, Tex. Soon after building was begun on the San Antonio & Aransas Pass, he was put in charge of traffic on that road, and was rapidly advanced to the positions of Assistant General Manager and then of General Manager. In April, 1893, Mr. Yoakum was made General Manager of the Gulf, Colorado & Santa Fe, and soon after he was elected Third Vice-President of the same company, which position he retained until elected Vice-President and General Manager of his present company on July 15, 1896.

—Mr. John W. Taylor, as already noted, became Chief Engineer on June 1 of the Terminal Railroad Association of St. Louis. He also serves in the same capacity on the East St. Louis Electric Street Railroad, which is owned by the company. Mr. Taylor was born at Decatur, Ill., December 9, 1866, and was graduated at the University of Illinois in 1888. During the summers of 1886 and 1887 he worked as chainman, rodman and draughtsman for the St. Louis & Chicago, and in the latter part of 1888 as draughtsman on construction of the Paducah Division of the St. Louis, Alton & Terre Haute. After spending three years in architectural business at Knoxville, Tenn., in January, 1892, he entered the service of his present company, the Terminal Railroad Association of St. Louis, as Assistant Engineer on Construction of the Union Station. He was appointed Resident Engineer of the same company in May of the following year, and Engineer of Maintenance of Way in September, 1895.



ELECTIONS AND APPOINTMENTS.

Caldwell & Northern.—L. C. Watson, heretofore General Manager, has been appointed General Superintendent.

Canadian Pacific.—C. Murphy, heretofore Acting Division Superintendent, has been appointed Superintendent of the Chapleau Division, with headquarters at Chapleau, Ont., effective June 11. T. Hay, heretofore Division Superintendent at Schreiber, Ont., has been appointed Division Superintendent at North Bay, Ont., succeeding T. J. Kennedy, resigned. Mr. Hay is succeeded at Schreiber, Ont., by R. J. E. Chapple, with the title of Acting Division Superintendent.

Chattanooga Southern.—A. W. Lefeber, General Passenger Agent at Chattanooga, Tenn., has resigned.

Chicago & Alton.—W. D. Cornish has been elected Vice-President. Mr. Cornish is also Vice-President of the Oregon Short Line and the Union Pacific.

Chicago Great Western.—C. P. Stembel has been appointed Division Superintendent, with headquarters at Des Moines, Ia.

Chicago Terminal Transfer.—The position of Purchasing Agent has been abolished.

Colorado & Southern.—W. E. Fowler, Master Car Builder at Denver, Colo., has resigned and the position is abolished, effective July 1.

Gulf & Manitoba.—George M. Brown has been appointed Chief Engineer and S. Keeler General Purchasing Agent, with headquarters at Beaver Falls, Minn.

Interstate Car Transfer.—John J. Baulch has been appointed Traffic Manager, with headquarters at St. Louis, Mo., effective June 23.

Iowa Central.—E. Hawley has been elected President, succeeding R. J. Kimball, resigned; F. H. Davis, First Vice-President, and L. F. Day, Second Vice-President and General Manager. All are officers of the Minneapolis & St. Louis. The following new Directors, including those above mentioned, have been elected: John E. Searles, L. C. Weir, E. Langdon, T. P. Shonts, Paul Morton and G. Crocker.

Leavenworth, Kansas & Western.—O. D. Chadwick has been appointed Supervisor of Bridges and Buildings, with headquarters at Holton, Kan., succeeding W. H. Petersen, resigned.

Michigan Central.—D. F. McBain has been appointed Master Mechanic, with headquarters at Chicago, Ill., succeeding J. G. Riley, resigned.

Northern Pacific.—On June 16 the property of the St. Paul & Duluth was transferred to the N. P., and the jurisdiction of the various officers of the N. P. is extended over the S. P. & D. A. L. Craig has been appointed Assistant General Passenger Agent. The jurisdiction of A. D. Charlton, Assistant General Passenger Agent at Portland, Ore., has been extended to cover all local passenger and through east-bound business originating west of the Montana-Idaho State line. C. E. Stone has been appointed General Passenger Agent in immediate charge of St. Paul-Duluth passenger business, and such other business as may be assigned to him, effective June 18. W. W. Broughton has been appointed Assistant General Freight Agent.

Pennsylvania Co.—On June 25 the headquarters of the Erie & Ashtabula Division of the Northwest System were transferred from Lawrence Junction, Pa., to New Castle, Pa.

Pittsburgh, Johnstown, Ebensburg & Eastern.—S. M. Brophy has been appointed Superintendent of the Altoona Division and does not succeed Mr. Reed, Superintendent of the Main Line Division, as stated last week. (p. 433.)

Rockaway Valley.—The officers of this company are: President, Charles D. Haines; Vice-President, E. T. Haines; and Secretary and Treasurer, L. E. Spencer. The following new Directors have been elected: G. Kingsley, A. Smith, T. F. Woodruff, M. R. Marks and L. E. Spencer.

St. Joseph & Grand Island.—J. Berlingett, formerly Division Superintendent of the Chicago Great Western, has been appointed Superintendent of the S. J. & G. I., with headquarters at St. Joseph, Mo., succeeding A. M. Morey. H. T. Reigart has been appointed Purchasing Agent, with headquarters at St. Joseph, Mo., succeeding G. D. Berry, resigned. A. C. Hinckley, Master Mechanic at St. Joseph, Mo., has resigned.

Southern Pacific.—J. H. Wallace has been appointed Engineer Maintenance of Way of the Pacific System and Lines in Oregon, succeeding W. G. Curtis, deceased. John D. Isaacs succeeds Mr. Wallace as Assistant Engineer Maintenance of Way of the same System and Lines in Oregon, with headquarters at San Francisco, Cal., effective July 1. The position of Second Assistant Engineer Maintenance of Way, heretofore held by Mr. Isaacs, is abolished.

Terminal R. R. Association of St. Louis.—W. C. Wilson has been appointed Master Mechanic of this company and the St. Louis Merchants Bridge Terminal, succeeding H. M. Smith, resigned.

RAILROAD CONSTRUCTION.

New Incorporations, Surveys, Etc.

AMERICAN RAILROAD & LUMBER.—It is proposed to extend this company's line in Mexico from Yondese southwest to the Pacific coast. R. L. Foster, of Mexico City, is General Manager.

BANGOR & AROOSTOOK.—The village of Greenville, Me., is endeavoring to get this company to build a branch from Greenville Junction into the village. It is expected that $20,000 will be offered.

BELLINGHAM BAY & BRITISH COLUMBIA.—J. G. Fairfowl, who has 16½ miles of contract for the extensionn from Sumas, Wash., southeast 23 miles to Comells, has taken the contract for the rest of the extension. (June 1, p. 364.)

CHICAGO & NORTHWESTERN.—Surveys are in progress for the recently incorporated Princeton & Northwestern Line from Princeton, Wis., northwest about 100 miles to the Chicago, St. Paul, Minneapolis & Omaha Line at Marchfield. (P. & N., June 22, p. 434.)

CHICAGO, INDIANA & EASTERN.—The townships of Muncie and Center, Ind., have voted $75,000 aid for the extension of this line from Matthews southeast 48 miles via Muncie to Richmond. It is stated that the section to Muncie, 16 miles, is to be completed Jan. 1 next. (Oct. 6, p. 701.)

CHICAGO, MILWAUKEE & ST. PAUL.—The line from Preston to Reno, Minn., 57.77 miles, is to be made standard gage. It is stated that contracts are already let and work is to be begun at once.

CINCINNATI & LICKING RIVER.—The company expects to build this season from Brooksville, Ky., to Johnson Junction, about 28 miles, connecting the Brooksville and the Covington, Flemingsburg & Ashland, and to extend the line still further some 18 or 20 miles from Hillsboro to a connection with the Chesapeake & Ohio at Salt Lick, or Morehead, Ky. The Chesapeake & Ohio is the company's outlet at Wellsburg, which is 40 miles from Cincinnati. The survey for the first 28 miles is progressing rapidly and the company will soon be ready to ask for bids for building. There will be one tunnel about 200 yds. long at Brooksville, and one or three bridges over the north fork of Licking River, each about 100 ft. long. There will also be two bridges on the extension beyond Hillsboro. The company will use 70-lb. rails. (June 22, p. 434.) S. S. Puckett, Yellow Springs, O., is President. (Official.)

CINCINNATI CONNECTING BELT.—This connecting line, now building around the north side of Cincinnati, O., runs from a connection with the Cincinnati, Portsmouth & Virginia and the Cincinnati, Lebanon & Northern roads at Idlewild, three miles out of Cincinnati. Through these roads it connects with the Pennsylvania and the Louisville & Nashville. It then runs northwest, crossing the Baltimore & Ohio Southwestern at grade at Bond Hill, to which point it is now operative. It crosses the Cleveland, Cincinnati, Chicago & St. Louis at Elmwood overhead, having interchange tracks with that company at their Elmwood yards. It connects with the Cincinnati, Hamilton & Dayton and with the Ivorydale & Mill Creek Valley roads at Ivorydale. For the present it is to be used for freight trains only, and it is expected that it will be completed within the next 60 days. G. D. Rhodes, of Carlisle Building, Cincinnati, is General Manager. (Official.)

COPPER RANGE.—The company is reported building a branch from the Baltic stamp mill to the Champion copper mine in Michigan, 4.3 miles.

COSHOTI & NORTHWESTERN.—Grading is to be begun within 30 days, according to report on this line from Thornton, N. M., to Bland, 25 miles, with 15 miles of branches. The Chemical National Bank, New York, is reported to have bought $1,500,000 bonds. James H. Purdy, of Thornton, N. M., is President. (April 13, p. 245.)

DENVER & RIO GRANDE.—The directors, according to report, have voted to expend $600,000 in building a branch line to Silver Cliff, Colo., to connect with mines.

FORT WAYNE & BUTLER.—This company has been incorporated in Indiana to build the line referred to below under the Wabash, from Fort Wayne, Ind., northeast about 28 miles to Butler. Surveys are reported in progress.

FRANKFORT & CINCINNATI.—An extension is proposed from Paris, Ky., into Morgan County, 80 miles.

ILLINOIS & WISCONSIN.—This company was incorporated in Illinois, June 23, with a capital stock of $100,000, to build a railroad from Morris, Grundy County, Ill., to run north through the Counties of Grundy, La Salle and DeKalb to Sycamore, and thence north through McHenry County, Ill., and Walworth County, Wis., to Lake Geneva, Wis., with branches to DeKalb, Belvidere, Joliet and Kankakee, Ill., and to the State line in Will or Kankakee Counties. The directors are: David Nichol, Morris, Ill.; John Moore, Jr., Lisbon, Ill.; Louis Rohrer, Sandwich, Ill.; Roren Woodward, Marengo, Ill.; Sidney B. Jones, O. P. Applegate, George I. Hicks, M. J. Cahill, M. H. Buckley, Frank D. Fuller, Frank J. Baker and Preston McGrain, all of Chicago.

ILLINOIS CENTRAL.—All the right of way is obtained in Lowndes County, Miss., for the extension northeast to Winfield, Ala. (Feb. 23, p. 128.)

ILLINOIS SOUTHERN.—An officer writes that the company does not contemplate building an extension from Salem, Ill., to Terre Haute at present. (June 15, p. 407.)

MERIDIAN & EASTERN.—The Governor of Mississippi has approved of the charter of this company to build a railroad from Meridian east into the coal fields of Alabama.

MISCELLANEOUS COMPANIES.—The Andalusia Railway & Copper Co., of Dunkirk, N. Y., has been incorporated in West Virginia, with a capital stock of $5,000,000, to do a general development business. Among the incorporators are E. S. Allen, Morris, N. Y., and Albert E. Nugent, Dunkirk, N. Y.

The McNair & Wade Land Co. has been formed at Montbrook, Fla., with a capital stock of $200,000, to deal in lands, to build and operate railroads, etc. N. G. Wade, of Montbrook, is President.

MOREHEAD & WEST LIBERTY.—This company was incorporated in Kentucky, June 21, with a capital stock of $600,000, to build a railroad from Morehead south about 20 miles to West Liberty. Alexander Harding, of Philadelphia, Pa., is President, and W. A. Young, of Morehead, Vice-President.

NEW YORK ROADS.—Surveys are completed for the line of the Lackawanna Iron & Steel Co. at Buffalo. (June 15, p. 408.)

NORFOLK, NEWPORT NEWS & OLD POINT TERMINAL.—This company was incorporated in Virginia, June 23, with a capital stock of from $10,000 to $50,000. David Lowdenburg is President. The main office is at Norfolk.

NORTHERN CENTRAL.—This line is being graded from Buffalo City, Ark., to Yellville, 20 miles. Track laying is to be begun about July 1. W. E. Winner, of Kansas City, Mo., is President. (March 16, p. 178.)

ONTARIO ROADS.—The Spanish River Pulp Co. has completed plans for building a spur from the Sault Ste. Marie branch to the company's mills at Webbwood.

PITTSBURGH, BINGHAMTON & EASTERN.—Surveys are reported in progress for this line from Monroe, Bradford County, Pa., to Towanda. (June 8, p. 380.)

PLANT SYSTEM.—The Railroad Commissioners are acting on a petition to improve the connection between the Plant System and the Florida East Coast at Orange Junction, Fla.

PONAGANSET.—The Rhode Island Legislature has amended the charter of this company, incorporated in May, 1869, extending the time in which the company may organize to June, 1903, and making valid all proceedings under the old charter. The time for completing the road is extended to June, 1905. The company was incorporated, with a capital stock of $400,000, to build a steam road from Hope Village through the villages of Richmond, Rockland and Ponaganset to Killingly, Conn. Among the incorporators named in the incorporation of 1869 are: Alanson Steere, Charles Jackson and John H. Barden.

PORT CLARENCE & CAPE NOME & NORTON BAY.—This company was incorporated in Delaware, June 23, with a capital stock of $1,000,000, to build and operate railroads in Alaska.

SOUTHERN PACIFIC.—Grading is in progress on a cut-off below San Francisco, to run south 10½ miles to San Bruno. It will require five tunnels, and is to be completed by November, 1901.

The City Council, of Stockton, Cal., has granted the application for certain right of way through that city. (March 16, p. 178.)

TEXAS & PACIFIC.—Thirty-six carloads of rails are reported received at Texarkana, Tex., for relaying the line from that city toward El Paso.

UNION PACIFIC.—An officer writes that the report is not correct that his company will build a cut-off between Evanston, Wyo., and Ogden, Utah. (June 15, p. 408.)

WABASH.—An officer writes that the company has never given serious consideration to building a cut-off from Fort Wayne, Ind., northeast to Butler. (June 8, p. 380.)

GENERAL RAILROAD NEWS.

ARKANSAS, LOUISIANA & SOUTHERN.—This property has passed into the hands of the Louisiana & Arkansas. It extends from Sibley, La., north 22 miles to Cotton Valley. (May. 18, p. 330.)

BISMARCK, WASHBURN & GREAT FALLS.—This company has filed a mortgage to the Central Trust Co., New York, as trustee, to secure $7,000,000 30-year 5 per cent. gold bonds, due Jan. 1, 1930. Of these bonds, $600,000 is issuable on the 46 miles from Bismarck to Washburn, now building; of which 26 miles will be completed in July and the rest about Oct. 1. W. D. Washburn is President, Minneapolis, Minn.

BOSTON & ALBANY.—The Massachusetts Senate, on June 26, by a vote of 25 to 5, passed the bill to lease the B. & A. to the New York Central. (June 15, p. 408.)

CHESAPEAKE & WESTERN.—This property has been acquired by a New York syndicate headed by De Witt Smith, through the purchase of a majority of the stock and bonds. The line is completed from Elkton, Va., to Bridgewater, 26.67 miles.

CLEVELAND, ELYRIA & WESTERN.—This company was formed, June 20, by the consolidation of the Cleveland, Berea, Elyria & Oberlin, the Lorain County and the Oberlin & Wellington companies, with a capital stock of $2,000,000. This is an electric line which, when completed, will extend from Cleveland west through Berea, Elyria and Oberlin to Wellington, with a branch to Lorain. It is also proposed to build the line on to Norwalk.

EUREKA & PALISADE.—The U. S. District Court, at Carson, Nev., on June 12, appointed Mark Requa, of San Francisco, as receiver of this road, which runs from Palisade, Nev., to Eureka, 84 miles.

FITCHBURG.—The Massachusetts House of Representatives, on June 26, by a vote of 147 to 39, passed to a third reading the bill approving the lease of the Fitchburg to the Boston & Maine for 99 years. (June 15, p. 408.)

FONDA, JOHNSTOWN & GLOVERSVILLE.—The New York Railroad Commission has approved the proposition to increase the capital stock to $600,000 by the exchange of $300,000 for a like amount of the Cayadutta Electric, now leased. (June 1, p. 364.)

GRAND TRUNK.—Wellington, Grey & Bruce bonds to the amount of £3,200 have been drawn for payment at par at the company's office in Montreal or in London on July 2.

INDIANA, ILLINOIS & IOWA.—A special meeting of the stockholders will be held in Chicago, July 24, to vote on the purchase of the Clinton & Streator, which is about completed from Streator west some 35 miles to Bureau Junction. A vote will also be taken on the authorization of a mortgage on the parent company's property not to exceed $12,000,000, maturing 1950, with interest not to exceed 5 per cent.

IOWA CENTRAL.—This property has come under the control of men who dominate the Minneapolis & St. Louis and the two properties will be operated hereafter in close connection. The control was obtained through purchases of the common stock in the open market. The road, including leased lines and trackage, comprises 508.98 miles.

KANSAS CITY SOUTHERN.—The company has made its mortgage for $30,000,000 to the Mercantile Trust Co., New York, as trustee.

KANSAS, OKLAHOMA CENTRAL & SOUTHWESTERN.—This property is to be sold at public auction, June 30, to satisfy a mortgage of $585,433. The road is completed from Independence, Kan., south 85 miles to Owasso, I. T., and is controlled by the Atchison, Topeka & Santa Fe.

KENTUCKY & INDIANA BRIDGE.—A plan of reorganization has been filed in the U. S. Court at Louisville, Ky., by Judson Harmon and Judge Alexander P. Humphreys, purchasers of the property. The plan provides for the creation of $2,500,000 of 4 per cent. bonds and of $75,000 capital stock. The stock is to be owned by the Baltimore & Ohio Southwestern, the Southern Railway of Kentucky (owned by the Southern), and the Chicago, Indianapolis & Louisville. It is stated that these companies have expended $948,445 in acquiring debts and claims against the old company in addition to the $1,700,000 paid for the property at foreclosure. (Feb. 16, p. 112.)

LOUISVILLE, EVANSVILLE & ST. LOUIS.—J. P. Morgan & Co., who are acting as the reorganization syndicate, have announced a plan of reorganization to which the Southern Ry. has become a party. It is proposed to issue Southern Ry., St. Louis Division, first mortgage 4 per cent. 50-year gold bonds, bearing interest from Jan. 1, 1901. These new bonds will be exchanged at par for old securities as follows: For each $1,000 Evansville, Rockport & Eastern first mortgage 6 per cent. bond, $1,180 in new bonds; for L. E. & St. L. first mortgage 6 per cent. bonds, $1,300 in new bonds; for L., E. & St. L. second mortgage 6 per cent. bonds, $700; for L., E. & St. L. first mortgage consolidated 5's, $750; for Huntingburg, Tell City & Cannelton first mortgage 6's, $165; for L., E. & St. L. general mortgage 4's, $75 in new bonds. Holders of these bonds must deposit the same with coupons on or before July 16. A majority of all the bonds has been acquired except the second mortgage 6's and the general mortgage 4's. The committee appointed by the holders of the first consolidated mortgage bonds recommends the acceptance of the plan. (June 15, p. 408.)

NELSON & FORT SHEPPARD.—An officer writes that the Canadian Pacific has bought from this company a short section forming an entrance for the C. P. R. into Nelson, B. C., but that the N. & F. S. continues to run into Nelson as formerly. The press reports that the entire N. & F. S. has been bought by the C. P. R. are incorrect.

PLANT SYSTEM.—The steamships of this company and the Florida East Coast, which operate from Florida ports, have been consolidated. There is to be no consolidation, however, of the two railroad systems.

ST. PAUL & DULUTH.—The Northern Pacific, in acquiring this property, has assumed all the company's indebtedness and buys the common stock at $60. The funded debt of the St. P. & D. aggregates about $5,000,000. The N. P. has filed a mortgage on the St. P. & D. to the Guaranty Trust Co., of New York, as trustee for $20,000,000 of 4 per cent. gold bonds, of which $9,215,000 is to be issued, representing the total stock of the road and its property, and the balance will be held for improvements. (June 22, p. 434.)

SHELBYVILLE & BLOOMFIELD.—This company has been incorporated in Kentucky, to take over the property of the old Shelbyville & Bloomfield, also known as the Northern Division of the Cumberland & Ohio, which has been operated by the Louisville & Nashville, and recently sold to the bondholders. This incorporation is preparatory to operating the road.

SOUTHERN.—Holders of East Tennessee, Virginia & Georgia first mortgage 7 per cent. bonds, due July 1, are notified that these will be paid at maturity at the office of J. P. Morgan & Co., New York. They may be exchanged for Southern first consolidated mortgage 5 per cent. gold bonds at 107½ ex. July coupon. Differences in price may be adjusted in cash, or with the proceeds of the old bonds at the option of the holder. (July 15, p. 408.)

TOLEDO, ST. LOUIS & KANSAS CITY.—The reorganization committee, of which Frederick P. Olcott is chairman, gives notice that the time for depositing the common and preferred stock under the reorganization plan has been extended to include July 16, after which no stock will be received except with penalty. (June 15, p. 408.)

UNION TERMINAL.—This company, whose organization has been already noted, was incorporated in Iowa, June 22, with a capital stock of $2,500,000, to take over the property of the Sioux City Terminal Railway & Warehouse Co. Among the provisions of the incorporation are that the company may build railroads from Sioux City east to the border line of Woodbury County, to the Big Sioux River, and north to the Northern state line. The directors are: John Cadwalader, Charles C. Harrison, Sydney L. Wright, John W. Hamer, William H. Blackford, Isaac J. Wistar, L. Riggs, Edwin S. Dixon and Adam A. Stull.